COMPLETED

Y4. C73/7: S. hrg. 99-464

S. Hrg. 99-464

AVIATION SAFETY

mf 133

ORIGINAL

HEARING

BEFORE THE

SUBCOMMITTEE ON AVIATION

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

NINETY-NINTH CONGRESS

FIRST SESSION

ON

AVIATION SAFETY

OCTOBER 1, 1985

Printed for the use of the
Committee on Commerce, Science, and Transportation

U.S. GOVERNMENT PRINTING OFFICE
56-711 O WASHINGTON : 1986

I

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

JOHN C. DANFORTH, Missouri, *Chairman*

BOB PACKWOOD, Oregon
BARRY GOLDWATER, Arizona
NANCY LANDON KASSEBAUM, Kansas
LARRY PRESSLER, South Dakota
SLADE GORTON, Washington
TED STEVENS, Alaska
BOB KASTEN, Wisconsin
PAUL S. TRIBLE, JR., Virginia

ERNEST F. HOLLINGS, South Carolina
RUSSELL B. LONG, Louisiana
DANIEL K. INOUYE, Hawaii
WENDELL H. FORD, Kentucky
DONALD W. RIEGLE, JR., Michigan
J. JAMES EXON, Nebraska
ALBERT GORE, JR., Tennessee
JOHN D. ROCKEFELLER IV, West Virginia

W. ALLEN MOORE, *Chief Counsel and Staff Director*
RALPH B. EVERETT, *Minority Chief Counsel and Staff Director*

SUBCOMMITTEE ON AVIATION

NANCY LANDON KASSEBAUM, Kansas, *Chairman*

BARRY GOLDWATER, Arizona
TED STEVENS, Alaska
PAUL S. TRIBLE, JR., Virginia

J. JAMES EXON, Nebraska
DANIEL K. INOUYE, Hawaii
WENDELL H. FORD, Kentucky

CONTENTS

Page
Opening statement by Senator Kassebaum 1
Opening statement by Senator Ford 2
Opening statement by Senator Hollings 2

LIST OF WITNESSES

Broderick, Anthony, Associate Administrator for Aviation Standards, FAA; Bernard S. Loeb, Chief of Safety Studies, Analysis Division, Bureau of Safety Programs, NTSB; Joel L. Slotsky, Evaluator-in-Charge, GAO; J. Roger Fleming, senior vice president, technical services, Air Transport Association, accompanied by Richard D. Taberey, senior vice president, maintenance operations, United Airlines; and Alan R. Stephen, vice president, operations, Regional Airline Association, accompanied by Richard Collie, director, Technical Services 134
  Prepared statement 138
Burnett, Hon. James, Chairman, NTSB 46
Engen, Hon. Donald D., Administrator, FAA 3
  Letter of September 30, 1985 20
  Prepared statement 23
  Questions of Senator Exon and the answers 26
  Questions of Senator Inouye and the answers 38
Gore, Hon. Albert, Jr., U.S. Senator from Tennessee 78
Jones, Larry, chairman, department of transportation, Task Force on Management and Employee Relationships; J. Roger Fleming, senior vice president, technical services, Air Tranport Association; Lou McNair, executive central air safety chairman, Air Line Pilots Association; Jack Ryan, Director of Air Traffic Operations, FAA; Joseph M. McGrail, Evaluator-in-Charge, GAO; and David R. Kelly, Chief of Operational, Factors Division, Bureau of Technology, NTSB 83
  Prepared statements:
    Mr. Fleming 86
    Mr. McNair 92
McCarthy, John, manager, Research Applications Program, National Center for Atmospheric Research; Lou McNair, executive central, air safety chairman, Air Line Pilots Association; Neal Blake, Deputy Assistant Administrator for Engineering, FAA; William G. Laynor, Department Director, Bureau of Technology, NTSB; and Arthur A. Schantz, Assignment Manager, GAO, accompanied by Virgil N. Schroeder, Evaluator-in-Charge 119
  Prepared statement 122
McLure, Herbert R., Associate Director, GAO, accompanied by Charles S. Cotton, Group Instructor 61
  Prepared statement 72
Specter, Hon. Arlen, U.S. Senator from Pennsylvania 43
  Letter of September 26, 1985 45

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

Chandler, Jerome Greer, article 160
Delta Air Lines, Inc., statement 149
Greene, Leonard M., president, Safe Flight Instrument Corp., letter of October 1, 1985 158
McCarthy, John and James Wilson, National Center for Atmospheric Research, article 163
Sulmonetti, Brian:
  Letter of September 10, 1985 56
  Statement 157
Werjefelt, Bertil, president, Xenex Corp., statement 150

AVIATION SAFETY

TUESDAY, OCTOBER 1, 1985

U.S. Senate,
Committee on Commerce, Science, and Transportation,
Subcommittee on Aviation,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:05 a.m., in room SR-253, Russell Senate Office Building, Hon. Nancy Kassebaum presiding.

Staff members assigned to this hearing: Steve Johnson, staff counsel and Steve Palmer, minority professional staff member.

OPENING STATEMENT BY SENATOR KASSEBAUM

Senator Kassebaum. The hearing will please come to order.

First I would like to express my appreciation and thanks to all the witnesses who are testifying this morning. We are very fortunate indeed to have such an extraordinary array of experts in the aviation field here today to offer their expertise and insight into this issue. This is a very important hearing, and we are attempting to cover a great deal of territory. As a result we will be limiting witness comments and testimony to 10 minutes and our questioning to 10 minutes.

Members of the first panel will present less testimony so that we can cover a large area of concern with the questions from the members of the subcommittee. Today's hearing will focus on three specific areas of aviation safety. We will begin by examining wind sheer, the technology to detect and avoid it, and procedures to fly out of it.

The second topic for discussion is air traffic control safety. Is the controller work force adequate, and is the system safe? Is the FAA hiring plan realistic? Are there reasons for recent increases in near misses in the air and on the ground?

Finally, we will examine aircraft inspections and maintenance. Is FAA surveillance activity adequate? What are the details of the FAA's plan to increase the inspector work force? Are there reasons for the disparities in FAA aircraft inspection practices?

The purpose of the hearing today is not to determine if aviation is safe. Aviation is the safest transportation mode in the world. There are 15,000 commercial flights daily in this country, 200,000 total flights including military, general, as well as commercial aviation movements daily. Aviation safety is a matter of vigorous enforcement of regulations and making sure that safety standards are effective as the industry continues to expand.

This is a very somber time in the aviation field. It is a challenging time because we have come up against an expanding air travelling public and competition that has exploded. At the same time we face the retirement of experienced professional air traffic controllers and pilots and maintenance personnel as well.

This poses specific safety questions that have to be answered, while not doubting the overall safety of aviation. It is in this light that we will be holding this hearing.

I would like to end my opening comments with a quote from Senator Goldwater. Senator Goldwater, unfortunately for us is chairing an Armed Services Committee this morning. He has said "Aviation in itself is not inherently dangerous, but to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity, or neglect."

Senator Ford, do you have any opening comment?

OPENING STATEMENT BY SENATOR FORD

Senator FORD. Yes, Madam Chairman.

First, let me commend you for calling this hearing. I think it is extremely important, I think, by the attendance here this morning, which indicates importance as it relates to others. I don't know about you during the August recess, but during my tour of my State during August, I had many people visit with me or ask questions across the State in asking me about the Government's role in aviation safety.

And it is hoped that as a result of today's oversight of the FAA that the public's confidence will be somewhat restored, and as I understand it, although there is not a common thread in the accidents, this has been, of course, everybody knows it, the worst year for aviation disasters.

I am sure you have noticed the publicity we have been getting just in the last few months. You just begin to look at all the news clippings just out of the paper here. You just keep right on going. You just keep right on writing. Keep right on writing about it, and I wonder if they have all the facts, and if they understand all the background that is there. When you begin to read all these, and the public reads that every day, a great deal of emphasis is going to be placed on it, and a great deal of concern as it relates to the safety.

I have a lot of questions today, Madam Chairman. I believe that openness can go a long way, and straightforward answers will go a long way in convincing the public that aviation is still the safest method of travel.

Again, I thank you for your interest in this, and look forward to the hearing.

Senator Hollings has an opening statement. He has been delayed but hopes to be here later on.

[The statement follows:]

OPENING STATEMENT BY SENATOR HOLLINGS

On January 1 of this year, an Eastern Boeing 727 slammed into the side of a mountain in Bolivia, killing all 29 people on board. What began on a sour note has turned into one of the worst years in aviation history.

Throughout 1985, accidents of large commercial aircraft, commuter airlines, and general aviation aircraft have occurred in this country and abroad with increasing regularity. These accidents have resulted in the deaths of well over 1,400 people worldwide. And the number of near-misses has skyrocketed, including the close call experience by an Eastern shuttle last week when an air traffic controller at National Airport sent a helicopter into the aircraft's path during take-off.

These hearings are extremely important as they will provide an opportunity to explore three of the most critical functions related to aviation safety. Research into the effect of whether on aircraft operations and the enlarging and stregthening of the FAA's controller and aviation inspection workforces are critical steps that must be taken to further reduce the change of catastrophe in our air tranportion system.

We are so often told that our aviation system is safe. Yet, must continue to do all we can to ensure the safe flight of all airline passengers. We have no greater responsibility, and I intend to work to make that objective a reality.

Senator KASSEBAUM. As our opening witness, we have no finer example, I think, of someone who is sensitive to the concerns that have been raised about aviation safety. He is very much at the forefront of ensuring that the system is working. It is a pleasure to welcome Adm. Donald Engen, the Administrator of the Federal Aviation Administration.

Admiral Engen.

STATEMENT OF HON. DONALD D. ENGEN, ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Mr. ENGEN. Thank you, Madam Chairman. I appreciate it very much, and I appreciate the opportunity to appear here today.

First, I would like to commend you on the way the subcommittee's hearing is structured today so that key experts of the FAA and other segments of the aviation industry will appear together on this panel; so I think that is a very meaningful way to establish a dialog.

Before we discuss the topics of interest to the subcommittee, I would like to briefly give my assessment of the overall status of our national air transportation system. In a word, I believe that our system is indeed healthy. Certainly, there is more that remains to be done to make it better, and we are all working to do that, but the fact is that our air transportation system is delivering what we expect of it: safe and efficient travel.

When a passenger boards a U.S. air carrier, he or she is assured a level of protection afforded no where else in the world and by no other means of transportation. It is a system in which people are moved great distances comfortably and efficiently, in the span of mere hours. Airlines offer 1 million passengers a day the opportunity to select any of the roughly in excess of 14,000 scheduled flights in the United States. And, most importantly, 99.99 percent of those flights will reach their destinations without any incident.

I recognize and I am highly attuned to the concerns of the public and indeed am concerned myself about the recent incidents and accidents that have occurred both within and outside of the United States. Let me assure you that we of the FAA, in conjunction with the National Transportation Safety Board, are doing all that we can to address those problems that occur. Although much more remains to be determined during the course of the ongoing international accident investigations, there is a very important point to make about what we have seen thus far this year.

There is no common element shared in these tragic accidents, as you have highlighted, Madam Chairman. This means that their occurrence does not reflect a serious shortcoming or failure in the air transportation system itself which threatens the overall safety of that system. I believe that is a key point to remember.

Also, it should be noted that, despite the recent tragedies, the overall trend of accidents and fatality rates has been a positive one over the past decade and is continuing downward. And this is despite substantial growth in our air travel in the United States.

So, in short, I believe that we can continue to have great confidence in the American transportation system. I say this with a great deal of pride in the accomplishments of the FAA that we have been able to make toward the outstanding record of the system.

At the same time, though, I must recognize the commitment and the contributions of all segments of the aviation community toward constantly bettering the system. We must remember that the responsibility for assuring that the system operates safely does not rest solely with the FAA and with the Congress. It is a shared responsibility by all those who operate in the national air space system.

We can encourage safety in the air transportation industry. We can even prod operators toward following appropriate practices or punish them if they don't. But in the end, the overall record of our system will reflect the general commitment to safety of those who operate in the system.

After all, the FAA, despite its best intentions, and despite the best intentions of Congress, will never have the resources to inspect every flight or to monitor every maintenance operation on every aircraft. And I don't want to imply that we should. Instead, a system of rules and procedures must be in place that, when followed, will afford a high degree of safety. The FAA must then work with the operators not only to see that the proper system is put in place, but through surveillance and spot checking to see that the rules and regulations are indeed adhered to.

This is the appropriate balance that has been achieved within the aviation community over time. And it is a system that I know well. It has worked well, and in my view it continues to work well.

My prepared statement touches briefly on weather radar and the air traffic control system, near mid-air collisions, and inspector staffing, so I won't at this time mention those.

I do understand that the subcommittee is also interested in knowing of our efforts to reduce runway incursions. This is an area which I have stressed within the FAA, and where I expect to see improvements in the future based upon the number of positive steps that we are taking.

Finally, let me make one last observation about the phenomena that I see now as we evaluate this recent spate of international aviation accidents. And this is a phenomena that I have seen time and time again over the 40 years that I have been flying and trying to make our system better. I call it the "do something" syndrome. The idea is that because something terrible has happened, that we, the FAA, the Congress, the airlines, the pilots, must do something.

And, of course, the clear implication is that prior to that time, we have been doing nothing.

Well, let me tell you, Madam Chairman, you don't achieve the kind of safety record that we have achieved in this country by doing nothing. We are always doing something to make our system better. But the achievements in aviation safety are rarely accomplished by the quick fix. It is through steady research. It is the evaluation and the improvements that have brought us to where we are today. When you achieve a system wherein we have assurance that 99.99 percent of the time you reach your destination safely, eking out that last one-hundredth of 1 percent is not a proposition susceptible to some of the simple answers that are being so freely bandied about.

Let's say, for example, that we eventually determine exactly what caused the JAL aircraft accident in August. We will, of course, put into the system the fixes to prevent that from ever happening again. But it may well be that the combination of circumstances that caused that catastrophe will never occur again.

And certainly, what we fix to prevent the JAL type occurrence will do absolutely nothing to prevent the type of accident that happened at Manchester, England last month.

Now, I am not saying, nor do I mean to imply that we should just stand there and throw up our hands and walk away from these disasters. We must and we certainly will do everything we can to see that they never recur.

But we must, in our reaction to these disasters, focus on the system and look at how it is performing. Are we continuing the kind of fundamental research, the evaluation and implementation of programs that address the changing aviation environment? Are we doing something?

I believe the answer is a resounding yes. We have been doing something all along. Part of our problem is that this issue rarely arises outside the context of catastrophe. How many times have you seen the headlines out there that 12 months have gone without an accident, or we have gone 12 months without an operational error at Wichita Tower?

Those things happen and they are evidence that we are doing something. I readily admit that an accident is a failure in the system. But the kinds of things we do day in and day out in our system detect and correct other failures that never become accidents.

That is why we have the incredibly safe system that we have. Now, that concludes my opening remarks, Madam Chairman. I am pleased to make available today also for your panels, Mr. Anthony Broderick, Associate Administrator for Aviation Standards and Mr. Neal Blake, Deputy Associate Administrator for Engineering, to sit on the Weather Radar Panel; and Mr. Jack Ryan, Director of Air Traffic Operations, to sit on the panel covering air traffic issues.

Senator KASSEBAUM. Thank you very much, Admiral Engen.

Your full statement will be made a part of the record.

I would first like to ask about the safety of the air traffic control system. This is not a new question, and I think the FAA is to be commended for, really extraordinary efforts in rebuilding the air traffic control system under extremely adverse conditions.

But some problems do not seem to go away. A 1981 NTSB study, and the March 1982 Jones study, both point to stress and controller workloads as continuing problems. In 1983, 135 Washington Center controllers wrote to Administrator Helms complaining that controllers were working their positions for 2 or more hours of intense traffic.

The present GAO study reveals the same problem.

My question is, Is this a systemic problem which will not and should not be expected to go away? What can we do about it?

Mr. ENGEN. Madam Chairman, I spend most of my waking days working with our system, and as you know, I fly in it; I sample it; I go visit our people; I have been to our centers from Puerto Rico to Alaska. And I talk to people. We are doing a lot of things.

No organization can be static, and you have to always work for improvement. We are not perfect and there is overtime in some selected centers; for instance, in about six of our centers, we have overtime rates that we are trying to get down, and we are taking management actions to do this, but we are not there yet. But in the other 16 centers, we have done away with the overtime. It is completely done on a voluntary basis.

So we are moving forward and I do believe that what Mr. Jones has done, when I asked him to come back in 1984 after he had done his report in 1982, I asked him to look again, and Mr. Jones came to me and said there has been no change. You have virtually the same problems now that you had in 1982. And I said, I asked him, you know, how long will it take for us to be effective. And he said, well, it depends upon your management actions and it depends upon the passage of time. It will take a long time to turn around attitudes within the air traffic system.

And I went to private industry to ask private industry about this, and I find that in a large corporation, they sometimes think in terms of 10, 15 years to turn around attitudes. So we are dealing with a long-term problem, Madam Chairman, and it is one that I am dedicated to licking. And as I go about in the system and talk to my people, I would like to report to you, though, that the morale is indeed good. There are people out there who are dissatisfied, as there are in any organization, you will find people who are not satisfied with their conditions.

And I need to address those concerns and I need to work with those people, and we are.

Senator KASSEBAUM. But I go back to the fact that these problems have been with us for a long time, and I know you are sensitive to this. Perhaps now that you are administration, FAA is begining to recognize the need for management change.

On the other hand, I don't know how much time we have. It seems to me that the system is expanding enormously, and the use of that system is increasing accordingly. We simply must be more aggressive in addressing the need to maintain the level of professional expertise in the system.

Do we need to look at grandfathering-in personnel such as retirees so that we can keep some of the professionals aboard? I question whether it is simply a question of numbers, or, if that might not in fact compound some of the problems in morale and the work force. I just don't believe, Admiral Engen, that those questions have been sufficiently addressed.

Maybe it starts with a realistic recognition that there is a problem with controller morale.

Mr. **Engen**. When I walked in the door, I recognized that we had a problem.

Senator **Kassebaum**. You mean here or at the air traffic control tower?

Mr. **Engen**. A year and a half ago. And I was aware of this. But let me tell you, morale is satisfaction with your job. In the FAA, we have good morale. We have a good economic wage for services rendered. I find people are proud of what they are doing. They are dedicated to the system. They are wonderful, wonderful people, true professionals, and the system is maturing.

Now, you say do we have time? We are keeping the system safe. I will not allow the system to become unsafe. We metered down last year on airline schedules. The reason I went to the airlines was to depeak and to cut down on some peaking. The airlines cooperated. That was an initiative which had a beneficial effect upon the system. And that is part of the working conditions.

But we want to remember that we of the FAA are there to provide a service. We are not there for ourselves. We need to continue to provide that service 24 hours a day, 365 days a year, which we do, and then we deal with our morale in addition to that. So please remember that we will keep it safe.

You mentioned grandfathering. And what happens to Government workers is, of course, Governmentwide, and in the air traffic control system they are Government workers. And if somebody is going to change the retirement rules, it is going to have an effect on the air traffic control system, just as it will the Department of Agriculture.

Senator **Kassebaum**. Unless we would make an exception.

Mr. **Engen**. Yes, ma'am. And I would like to support what you say, because I think it is very important that we retain the quality of people that we have in the FAA and maintain that system safely.

Senator **Kassebaum**. The House Subcommittee on Aviation held a hearing on the first of September and recommended that air traffic volume be restricted to levels consistent with air traffic control capacity.

Do you see this as something that should be considered?

Mr. **Engen**. Our goal in the FAA and my personal goal is to let air commerce flow freely, but it is going to do so safely. In a sense, we do that, but I see no reason to physically go out and restrict people's ability to fly in these United States from any city.

Now then, having said that, we maintain central flow control, and when the weather does not become bad and when there is a line of thunderstorms along the east coast, we work directly with the airlines and we begin to restrict that traffic for that particular portion of that day. And we work in a real time basis.

And so in that sense, we do meter the traffic. But I find—I have found no reason to constrain the en route traffic. Now then, when you arrive at the airport—and that is where aviation starts and stops—at all airports—we do have a problem in the United States in some key areas with a lack of concrete macadam. And you can only put so many airplanes on so many runways at a single time, and that is a constraint that we are working with now, as you know, in the four or five high density airports, but that is the only constraint that we have.

Senator **Kassebaum**. Air traffic accidents are up dramatically and critics of the system often ask what the FAA is going to do about it. I would like to put that question to you.

What is the FAA going to do about it now, and what does it plan to do in the future?

Mr. **Engen**. You know my background and my biases with respect to aviation safety. Everyone in the FAA is dedicated to safety And when I assumed my role as Administrator of the FAA, the first thing I did was to take the Office of Aviation Safety in the FAA and place it directly under the Administrator, because I believe that any CEO should have the staff function of safety reporting directly to him or her.

I did that, and that has had a salutory effect. It as enhanced, I believe, our ability to work with the NTSB to implement their recommendations. We are very dedicated to doing that. I believe in the Independent Safety Board Act. I believe in the NTSB. And I think it is a good system, and we want to respond to that, so we are working on those and trying to reduce the numbers of recommendations that we have out there.

We work daily with respect to the accidents, and there has been a series of tragic international accidents. But the numbers of accidents in the United States, if you just look at accidents, are not dramatically up. One accident is one too many. But if you look at the rates, our problem is that we are carrying so many people. When you lose a B-747 in Japan with 525 people on it, or you lose a DC-10 or something like that, or a 747 with a lot of people on it, it is catastrophic, and that is a problem we have to deal with.

Now, what are we doing about it? I have gone out to my people and we are resolutely enforcing the Federal Aviation Regulations. I want to assure you that I will implement those regulations as strongly as I can.

We have increased our surveillance of the air carriers. We are increasing our surveillance of general aviation. Secretary Dole has approved the increase in the number of inspectors that we can have, and you will see us continuing to bear down on the system out there, to be sure that everybody abides by the rules, because safety is indeed a shared responsibility.

Senator **Kassebaum**. Thank you very much, Admiral Engen.

Senator Ford.

Senator **Ford**. Thank you, Madam Chairman.

Mr. Administrator, I have some questions. If I don't finish them on this round, Madam Chairman, I would like to come back before we let the admiral off the hot seat, so to speak.

Admiral, I can't help but wonder if the reduction in personnel in 1981, particularly in inspectors, has caused your recent flurry of bad press.

In your statement, or response to the chairman's question, you said that Secretary Dole had authorized you to increase that number. What was it reduced to in 1981, and how fast are you increasing that number and bringing inspectors on board?

Mr. ENGEN. As you know, Senator Ford, between about 1978 and about 1983, we reduced the number of inspectors down to about 508, I believe.

Senator FORD. From what number?

Mr. ENGEN. From 674.

Senator FORD. 674 to 508?

Mr. ENGEN. Yes. And I will provide for the record the exact low level, but the 674 is correct. And when Secretary Dole came in and conducted the national air transportation inspection, she saw at that time—and this was before I joined the agency—the need to increase the inspector force again and she authorized the immediate increase by 25 percent of that inspector force.

It resides today at 674 for the air carrier inspector force. And it is that group that we are talking about increasing in the ensuing years, 1986, 1987, 1988.

Senator FORD. You mean it is now at 674?

Mr. ENGEN. Yes, sir.

Senator FORD. So it is back up to its previous amount and you are going to add additional inspectors beyond that?

Mr. ENGEN. Yes, sir; we are.

Senator FORD. At what rate?

Mr. ENGEN. We have gone in and asked—I can address 1986 and tell you what my plans are for 1987; 150 additional in 1986 which has been approved by the Secretary, and the President has authorized this; 200 additional inspectors and support personnel in 1987 and then we will pick up the remainder to a total of about 500 in the following fiscal year.

Senator FORD. That is 500 over, so you will have about 1,100 on board?

Mr. ENGEN. Yes, sir. But I would like to retain the flexibility of making some of those people support personnel. They will not all be inspectors as such. I am working on those numbers right now as a result of——

Senator FORD. How soon can we have a list of those numbers?

Mr. ENGEN. I can provide them for the record. I would be pleased to.

[The following information was subsequently received for the record:]

The FAA's FY 1986 budget request to Congress reflected staffing levels of 1,610 inspectors, of which 674 were air carrier inspectors and the remainder general aviation inspectors. Clerical supporting staff numbered 311. The proposed FY 86 increase in inspectors of 150 contemplates 54 additional air carrier and 96 additional general aviation inspectors. As new inspectors came on line, additional support staff will be necesary. At this time, we project the need for 88 additional support personel, with the addition of 62 anticipated in FY 87 and 26 in FY 88. Current projections also call for an added 262 inspectors to be phased in over FY 87 and 88, although a decision has not been made as to the specific breakdown between the air carrier and general aviation options. Present plans are to add 138 of these inspectors in FY 87 and the remaining 124 in FY 88.

Senator FORD. I would like to have those, Madam Chairman. Good. And I would like to have the breakdown between the number of inspectors and support.

When you say "support," are you talking about secretarial help?

Mr. **Engen**. Yes, I am.

Senator **Ford**. OK.

I have heard too much of this and read too much about this question, the projected accidents. If everything continues based on past averages, approximately how many accidents will occur as a result of wind shears between now and 1992 when Nexrad is scheduled to start being installed?

Mr. **Engen**. I never believe in projecting accidents, Senator, but if you look at the past, I think that we have averaged a wind shear accident about once every 2 years. But we are doing things right now to address wind shear. We are working on training right now. We are developing new systems right now.

So I wouldn't say that you could sit there and think that there would be one wind shear accident each 2 years. But in the past, there has been about one every 2 years.

Senator **Ford**. So really, you have not installed any new systems. You are doing some research.

Mr. **Engen**. We have installed new systems, sir. We have gone from 59 to 110 low-level wind shear alert systems throughout the United States. Secretary Dole almost doubled the number of wind shear alert systems that were authorized, and 70 of those are installed at this time with the remaining 41 to be installed by mid-1986.

Senator **Ford**. Was there one in Dallas?

Mr. **Engen**. Yes, there was.

Senator **Ford**. There was one?

Mr. **Engen**. Yes; there was.

Senator **Ford**. I do not know what my next question is, but something about that does not ring real good to me.

If it was there, why was it not in operation?

Mr. **Engen**. Well, the low level wind shear alert system reports what is going on, and therein lies its shortcoming, if you will. You have got to use everything you have got. You have got to use your eyeballs, you have got to use the pilot's eyeballs, you have got to use the controller's eyeballs, you have got to use the low-level wind shear alert system. It has worked very well.

For instance, just 6 weeks ago, on one day in Denver, CO, because of the low-level wind shear alert system, 10 pilots refused to take off and 3 refused to land. That is good. And it is working.

Senator **Ford**. Well, let me ask you this.

Is there any way that the Nexrad Program could be put into place faster, or could the Doppler portion be separated and installed earlier than 1992?

Mr. **Engen**. I think we are talking in terms of total installation, and I am dedicated to trying to move ahead as rapidly as possible.

The research and development for Nexrad, as you know, is being conducted by Sperry and Raytheon in a head-to-head competition. I intend to make the recommendation to award that next summer, and I intend—I hope that we will as soon thereafter in fiscal year 1988 begin to install those systems. So the systems will be coming on line.

Also, Senator Ford, there will be an adjunct to Nexrad, next generation radar, which will be terminal Doppler weather radar which we also plan to bring along.

But may I cite one other thing?

Senator **Ford**. Go ahead. No, go ahead, that is fine.

Mr. **Engen**. There are systems which can be installed in the cockpit, and we are continuing to look at airborne systems so that pilots will have the opportunity to anticipate wind shear as well.

Senator **Ford**. Admiral, is it not one of the responsibilities of the FAA to oversee maintenance of aircraft, and can you explain to me FAA's responsibility in this area, and also tell me if FAA requires maintenance records to be kept on aircraft.

Mr. **Engen**. If I can answer the last question first, the answer is yes, sir, we do require that records be kept, and we do inspect all airlines, all air carriers. The FAA has an aggressive program, and you have got to remember that the way our system works is that it is incumbent upon the airline itself, the corporation, to follow the Federal Aviation Regulations. The FAA will come in and spot check, monitor, oversee, but the responsibility is upon the operator to maintain those regulations, and when I find that the operator does not maintain those regulations, we step in and adjudge civil penalties.

Senator **Ford**. Well, in light of your response, I am amazed at what I understand what recently occurred. An airline with an outstanding safety record purchased a large aircraft from another airline, and when that aircraft was delivered, they found little to be desired. There were parts, many problems including wrong parts on the airplane, and when they requested the maintenance records from the former owners, they found there were no such records available.

I understand under the circumstances, when it was reported to your office or to your organization, that they did come in and oversee it, even though there were new parts on the aircraft, it was obvious that there were new parts on the aircraft, your organization made them take them off, replace them with new parts and go through the whole litany, and in order to be sure that the aircraft was safe, they were doing what was responsible.

But where was your organization in that particular case? Now, I do not want to name airlines here openly, and I think it will come out, and others are already looking at it. Where should your organization have been under those circumstances?

Mr. **Engen**. Well, we, as I said, provide oversight, Senator Ford, and our responsibility is to be sure that people adhere to the FAA regulations. If somebody chooses not to adhere to them, our responsibility is to seek out that individual and get redress. I am not intimately familiar with the specific instances that you are talking about, but I do know that where we find there have been shortcuts or where the proper parts have not been installed in the airplane, we have taken action against those air carriers.

I would hope that in this instance that you are referring to here that our inspectors did step in and adjudge a penalty upon whoever it was that had not followed the regulations.

Senator **Ford**. I do not think that has occurred yet. I noticed in the paper where there was a large fine including but not—about dirty restrooms, you know. I would not care so much about how dirty the restroom is, I want the engine to be able to operate. I would rather for your people to be inspecting the outside of the airplane rather than the inside of the airplane.

Mr. **Engen**. We do.

Senator **Ford**. I have one more question that I want to ask. I was interested in listening to an interview with a flight attendant, who had been involved in an aircraft accident where there were fatalities, state that there was no such thing as a perfect accident. That alerted me, and I wondered what she meant. She meant that from the training she had received, based on what they suspected an accident would be like, that she had practiced over and over and over to evacuate that airplane in 90 seconds flat. But when she was involved in this accident, her actual experience was not comparable, and the tests beared little relationship to reality.

In light of this situation, I understand that the FAA within its regulatory authority will allow airlines to remove exits from a Boeing 747 aircraft, even though the exits were originally required for safety reasons.

With all the accidents that have occurred this year, it seems to me that you should be enhancing safety and passengers' ability to exit the aircraft in case of a fire rather than limiting the passengers' ability to exit.

Although, as I understand it, it is legal to remove the exits, you have written the carriers and asked that they do not remove these exits. Now, you are the Administrator and they have got the legal ability, probably a regulation, that says they can eliminate it, and then you are refuting the regulation.

Let me ask you then, what response have you received from the carriers, and do you have any changes to the regulation in mind, and when do you expect to finish your analysis?

Mr. **Engen**. You are absolutely correct, Senator, no accident is ever the same, and no matter how many times you practice, the events just do not come out that same way.

The reason that particular airplane had 10 exits was because it was designed to carry 550 people. We require by the FAA regulations one pair of exits, 2 exits, for every 110 people. The manufacturer had come to the FAA and requested redress because they were going to carry less than 440 people. My Northwest Mountain Region granted that approval because it met the regulations.

When I found out about it, I was concerned. With my background in safety and having come from the Safety Board, I looked at the regulations. It was indeed factual, correct with respect to the regulations. My purview is over U.S. air commerce. I wrote to the CEO's of every airline, every U.S. airline that was flying that particular airplane and said that in my honest opinion, that retaining the flexibility of the 10 exits was far better than reducing that flexibility because you never knew what was going to happen in an accident.

To my knowledge, all airlines have acceded to that. I have maintained the regulation without abrogating it, and I have achieved not having a reduction in the number of exits in U.S. air carriers.

Senator **Ford**. Thank you.

Mr. **Engen**. Oh, one last thing, please, if I could.

We did convene on September 2, 3, and 4 a specific conference to which I invited all of industry, the flight attendants, the pilots, both ALPA and ATA, and all the manufacturers and the airlines to come discuss our emergency exit from aircraft. From that we have a large tome which we are reducing, and we are going to go back and reexamine the regulations with a view to answering are they effective as they are now written.

Senator KASSEBAUM. Senator Rockefeller.

Senator ROCKEFELLER. Thank you, Madam Chairman.

I would like to divest myself of a comment or two, if I might, with your permission, and talk to the admiral at the same time and ask him several questions.

It is a fact, of course, that in 1980 there were no fatal accidents involving the U.S. airline industry, and obviously it is the hope of all of us today, yourself included, that these hearings that Madam Chairperson is conducting today will be helpful with respect to getting back to that kind of a number. But it is also true that commercial airlines have long been considered the safest and the best form of transportation available. But this year we have witnessed, and as a result, this hearing and many others, a grim sequence of plane crashes which have already produced a record number of fatalities.

Increasingly, people in my State and elsewhere are questioning whether enough is being done, which is precisely what you are talking about, to prevent terrible accidents like these.

Now, the airline industry and we in Government share this reponsibility. There is no question about that. We are not here just to grill you for public purposes. I mean, we share part of this responsibility along with you. It is our job to make sure that we are as fully committed to it as you are, that you have the funding necessary to carry out what it is that you need to do to make our airlines safe.

I personally have been nervous ever since airline deregulation was passed in 1978, because I felt at that time, and I do now, that what would happen would be that a number of the major airlines would clear out of some of the more rural States, which in fact did happen. American Airlines, United, and Eastern all were gone from West Virginia within a month or so, a couple of months. One of them is now back on a part time basis. But more important than that, I was concerned about what would airline deregulation do to safety, by which I mean as more commuters and smaller airlines came into the picture to fill the hole left by the departure of the major airlines, would there be the kind of competition or the kind of assets available to those commuters to build in the safety, to build in the training, to build in the maintenance which you all require and which is necessary.

Now, we have an American Airlines fine of $1.5 million which I think was stunning in some ways. Those of us who have worked with the coal mines over the years are accustomed to fines, and when people do not do a proper job, fines are part of the penalty that must be paid. But unfortunately, the penalty in the coal mines and in the air industry when something fails completely is that deaths are involved.

So I do not think there is any question on the part of any of us that the airlines and the FAA and the U.S. Government and the U.S. Senate have to understand that we are very serious about this problem, that we cannot tolerate, you cannot, we will not, the public will not tolerate any kind of shortcuts on safety.

I welcome the news that you have brought us this morning, Admiral, which I knew but which is reassuring to hear, that the FAA wants to add inspectors. On the other hand, I am also mindful of the fact that there was a cut of 25 percent in inspectors just at the time, several years postderegulation, that the number of airlines were increasing, the flights were increasing, loads were increasing. And whereas I am glad that you are back now close to where you were before, still you are I believe a couple of thousand short of where you would like to be, if I am not wrong, and that would be my first question.

I think you are on track in getting back to where you were but still several thousand short in terms of the controller situation, both those in the towers and those in between the airfields from where you were before. Is that not correct, that you are several thousand short?

Mr. ENGEN. Senator, let me see if I can split out two subjects, if I can. We are talking about two things, air traffic controllers and inspectors. They are different parts of the work force.

Senator ROCKEFELLER. I am talking about the controllers at the tower and those in between the towers that relay the planes along the routes.

Mr. ENGEN. All right. In talking about air traffic controllers, I am indeed 300 below that which has been authorized me. I have been authorized 14,306. We met that goal in February of this year, and subsequent to that it has attritted a little bit. That amounts to 2 percent of the work force, Senator Rockefeller. So we are 90 percent filled out.

We have gone out, Secretary Dole has gone forward and approved the increase in the numbers of air traffic controllers in the years 1986, and we intend to come in in 1987, as well, and raise that.

You mentioned that the 2,000——

Senator ROCKEFELLER. Will that bring you back to where you were prior to the strike?

Mr. ENGEN. Not in the numbers of individuals, it will not, because we had about 16,700 prior to the strike. We have 14,000 now. The difference in that, Senator Rockefeller, is the fact that we work in different ways now. Before this strike we worked about 4 hours on the boards at a time and 4 hours was spent in training, breaks, lunches, things like that; now we work 6 hours on the boards, and so when you equate that increase in the number of hours spent on the boards, which is done safely, we are getting more productivity from our people.

However, we are going in for increased air traffic controllers, and the reason for that is because we see the economy continuing to expand. I see air traffic volume continuing to go. We are operating today at 107 or 109 percent of the traffic volumes that we had in 1981, before August 3, 1981.

So I see that continuing, and so we are planning ahead, and we are filling up our controllers.

Senator ROCKEFELLER. But that leads me to exactly my point. In other words, the number of flights has increased, as the load has increased, the number of airlines has increased in the postderegulation period.

Mr. Engen. Yes, sir.

Senator Rockefeller. So that to say that you will be back to, let's say, the 14,000 person equivalency because of efficiencies and new ways of doing this for your air controllers is equal to what it was before, that might not be the case if in the meantime the number of flights, the number of airlines, the load per person has gone up, and that is the question I want to get to. Is the ratio of flights per controller at a steady level compared to what it was before?

Mr. Engen. Of course, it varies across these United States, and if you are in New York, it is greatly different than if you are in Houston.

Senator Rockefeller. Understood.

Mr. Engen. But we monitor this, and that is exactly why we went in for the increase because we saw the numbers of flights continuing to increase out there.

It is done safely today, sir. The numbers of flights—and the numbers of airlines really has not seemed to affect it so much. The number of airplanes out there have stayed virtually the same. So the numbers of airplanes flying are—they are flying more, more frequently. So that causes more flights.

Senator Rockefeller. So that you are saying there has only been about a 7-percent increase in the number of flights since that period.

Mr. Engen. Yes, sir.

Senator Rockefeller. May I ask one further question, too, on this matter of commuters as compared to large commercial airlines?

Has there been in recent years, let's say since deregulation, in your judgment a difference in the safety record of commuter airlines including private planes, as opposed to the large commercial carriers? Is there a fundamental attention to safety difference as between those two segments of our industry?

Mr. Engen. Let me take that in two steps, if I could, and let's talk about commuters, and I would say yes. Now, what do I mean? The accident rate in commuter airlines has improved markedly. The commuter airlines have continued to improve on their safety record. It is a graphic improvement, over the last 6 years.

In general aviation we are continuing to come down. Last year we had about 1,018 accidents in the United States. That is a new low. It is still to be determined what it will be this year, but I see the trends coming down. This aberration, the terrible tragedies we have had with the large airplanes internationally, if you look at it over the long term, I do not think you are going to see anything more than maybe just a gentle changing in the slope of the continuing decrease, or increase in safety in aviation.

The major airlines have had a bad year, and it is they that have had the bad accidents, but the commuter airlines are continuing to improve.

Senator Rockefeller. Now, I am a little bit confused because in answer to my question as to whether there was a difference as between commuters and the larger commercial, you said yes, there was; but then you said that the commuters are continuing to improve.

Does that mean that your net answer is that the safety record for commuters is overall better? It has been better?

Mr. **Engen**. The safety record of the commuter airlines is continuing to improve.

Senator **Rockefeller**. But vis-a-vis, compared to the large, commercial airlines, is there a comparison as between those two segments?

Mr. **Engen**. Well, I do not think I can really draw a direct comparison. If I took them all together, they would be continuing to improve, if you look at the long-term thing. If you look at the numbers of accidents, the record is continuing to improve. If you look at the number of fatalities, it has been a terrible year because of the large size of the airplanes that have been involved in the accidents.

Senator **Rockefeller**. Well, let me ask you this. If I could, if Senator Exon, Senator Kassebaum, and myself could give you any amount of money that you wanted for improving safety on commuter airlines or with respect to commuter airlines, what would be some ways with which you would apply that money?

Mr. **Engen**. In granting me my 1986 budget, Congress has given me the means to start that improvement, and that is to increase the numbers of inspectors that we have available in the system. I think that is a good adjunct.

I have sufficient money in the budget to manage the system safely. By that add-on in people for inspectors and increased number of air traffic controllers to meet the upsurge, if you will, in the traffic, I have what we need to continue to manage the system as it should be managed.

Senator **Rockefeller**. Thank you, Admiral.

Senator **Kassebaum**. Senator Rockefeller, I might just say that we are going to hold a separate hearing on the commuter services as soon as Senator Exon and I can work out a date that will be agreeable to everyone, probably November 5 or 6.

Senator **Rockefeller**. Excellent. Thank you. I would like very much to be here.

Senator **Kassebaum**. Senator Exon.

Senator **Exon**. Thank you, Madam Chairman.

Admiral Engen, welcome here. I think that with the amount of publicity that we have had, it must not be a great pleasure today to be the Administrator of the Federal Aviation Administration.

I for one feel that despite the publicity that we have, we have a safe system in the United States today. I think there is a lot of confidence left in the system.

Example: The other day when the Eastern Airline difficulties happened at Washington National, everybody got out of one plane and got on another. I do not know whether I would have had that much courage or not, but I think it indicates that there is a great deal of confidence in the system.

I happen to know in my conversations with you that you are working very hard to improve that.

The reason for this oversight, of course, is that there remains concern, legitimate concern, that are we doing enough. I have been listening to the questioning this morning, questioning of you as to what some of our previous policies were or not with regard to not having as many people on board, and I think that was a mistake. I am glad to see that you are moving now rather swiftly to correct that because I think we need more people to better assure even greater safety records in this great industry of ours.

You indicated in your testimony that you have gotten increased productivity, as I understood it, from the air traffic controllers by the previous arrangement that was 4 hours on and 4 hours off. And during that 4 hours off, part of that time was devoted, as I understood it, to increased training, with the rest of the time for rest and relaxation from this stressful job.

Now you have gone, as I understand, to 6 hours on and 2 hours off, is that correct?

Mr. ENGEN. That is correct, sir.

Senator EXON. I am a layman in this. I have no basis on which to ask this question except it crossed my mind. How did the 4 hours on and 4 hours off come about, and why was a change made to 6 to 2? I suspect that part of the reason for the change from 6 to 2 was that we had a tremendous shortage of air traffic controllers, and we required them to work 2 hours more.

That concerns me only as to not knowing whether the 4 hours on and 4 hours off was underutilizing these people. By the same token, I ask, is 6 hours on and 2 hours off, which is a pretty dramatic change, are we convinced that it should not be 5 on and 3 off?

You must have looked into that. Would you give us your advice on that particular item?

Mr. ENGEN. Yes, sir, Senator Exon. We very carefully look at the criteria for manning the scope as we look at the criteria for doing our inspection jobs in the other part of the FAA. We examine the working conditions. We look at what is required of the individual. And the 6-hour decision was made prior to my joining the FAA, but I certainly support that. I think that the facts show that that is not an undue amount of time for people to be gainfully employed out of an 8-hour period.

We looked at the breaks particularly. We looked to be sure that people had sufficient time off. If anything has suffered at all, Senator Exon, it would be the amount of training that we have been able to do because you have got to take your breaks. You just cannot drive people.

So we have gotten around that by using overtime. But the point I would like to make is that the 6 hours is indeed to our mind a proper amount. I would not want to etch it in stone. I would not want to say that I would never make it 5½ hours and 3½ hours. And I think we want to continue to look at this, as you work in different options. When you work in a tower, it is a little different than when you work in an en route center.

So I think we want to look at it very carefully and continue to examine it. But I feel in talking to my people, as I go about the system, I have received no complaints about the length of time that people are spending on the board.

Senator EXON. Well, if you do not have complaints, why is it that we keep hearing that the morale of the air traffic controllers is down? Is it the fact that they do not like this system?

Mr. ENGEN. Well, I think a lot of reasons, Senator Exon. Part of it is a little self-serving on the part of a small portion of people who would like to reorganize, and that serves their purposes. I think the majority of people feel that the system is functioning well, and they like the work place. Their morale is not down.

As I talk to people—and I recognize there might be a filter factor there when somebody talks to the Administrator, but let me tell you, when I go around and talk to people, we let out all the stops and they can say anything and everything they want to, and I get some good questions. I have yet to have anybody tell me that their morale is down. I have had good, strong complaints from individuals, and some of them very justified, which we try to deal with. But morale, sir, is not down.

Senator EXON. As a frequent air passenger traveler, are you telling me that I am just as safe as I was in that airplane when the controllers had 4 hours on and 4 hours off as I am now with the 6 and 2?

Mr. ENGEN. By statistics, sir, you are safer.

Senator EXON. You have sent up legislation that has not been introduced yet, as I understand it, that increases the penalties, civil penalties for violation from $1,000 to $10,000. What is that, just to get everybody's attention and make them a little more alert to the potential dangers here?

Mr. ENGEN. Well, in the Air Commerce Act of 1938, the $1,000 civil penalty was adjudged, and we have gone through almost 50 years now, and that is part on Secretary Dole and myself feeling that that value needs to be changed, indeed, to get people's attention. And we are talking about for a single occurrence, and we are talking about in the FAR-121 airliner or FAR-135 commuter regime where you carry passengers, and we want to be sure to get people's attention. We want to make darned sure that they listen to what we are saying.

Senator EXON. We are going to get into the commuter situation, and the chairman and I have been talking about this, so I will not go into that in detail except that I want to express my concern.

I am very much concerned, following up on what Senator Rockefeller brought up, that when we deregulated and we had this proliferation of commuters—and I travel commuter airlines a great deal—I have often wondered whether the commuter airlines are subjected to the same scrutiny as the major airlines.

Are they?

Mr. ENGEN. Yes, sir. Yes, they are. We have adopted standards to be sure that we are getting out to every commuter. In the past I have been disappointed in some instances where that has not been so, but I would like to assure you, sir, that our goal is to do it fair and equitably across the board, and we are working to make it so.

Senator EXON. Mr. Administrator, as you know, the Air Transport Association has done a study for improving the air traffic control system, and basically they are recommending, if I understand it, that a separate corporation be formed and that overall regulation for air traffic controllers be moved to an independent body outside of the FAA.

What is your opinion from what you know of that study at the present time?

Mr. **Engen**. First of all, I do not know anything about the study, and I read the paper this morning, and that is all I know.

I would reserve any judgment at all until I would have a chance to see just what it is that is being proposed. I would hasten to add that we have got to be sure that there is a continued emphasis on safety in the system, and we have got to be sure that we do not separate authority and responsibility, and I would like to look at that. Rather than comment on it now, I just would say I will look at it when I get a chance.

Senator **Exon**. Possibly, Madam Chairman, we might have a chance to get into that a little bit when we have the other hearing because I assume that Mr. Engen will be back at that time, and I think that is something we have to look at. Also, if you could, Mr. Engen, supply for the record for this hearing or the next time you appear figures to back up whether this 4 hours on and 4 hours off was properly changed to 6 and 2, and if we have reliable statistics to show that those people are not being overworked.

[The following information was subsequently received for the record:]

Time On Position

The change from about 4 to about 6 hours on a position does not result in the controller being overworked. The prestrike average of 4 to 4½ hours on position resulted from a situation of controller overstaffing rather than an agency policy. The staffing standards in use at that time provided the staffing needed to handle the traffic levels that occurred during the 2 peak hours of each shift. This resulted in overstaffing during the other 6 hours.

The staffing standards that we use now are based on each controller working 6½ hours per day on position. In practice, of course, the amount of time a controller spends on a position will vary from facility to facility and from day to day. It is affected by many variables such as the weather, the level of activity, the number of controllers actually available for duty on a given day, and the complexity of the position. Our policy is to provide a position change at least every 2 hours to controllers working radar positions. The 90 minutes we allow each controller for time off position provides adequate breaks, and also allows time for a meal away from the position. The traffic peaks are now handled by a more sophisticated traffic management system, improved scheduling, and, when necessary, by the use of overtime.

Senator **Exon**. I am guessing. Maybe with 4 hours on and 4 hours off we were not getting as much productivity as we need, but I have a question in my mind as to whether we are pushing too much in that area now. I still think that the mother of invention there was the fact that we did not have enough air traffic controllers. That is the real reason that we went to 6 hours on and 2 off, was it not?

Mr. **Engen**. Well, I do not know. I was not here.

Senator **Exon**. What else could we have done if we had not done that?

Mr. **Engen**. Let me say, Senator, that it is a very people-intensive organization. We rely on people to do it, and we must deal with people, and I, like you, am very interested in this, and I will be pleased to provide those records for you because I think it needs to be addressed.

We have supervisors on board who monitor people all the time.

In this people-intensive project of ours, no air traffic controller is left alone. We have somebody watching somebody, and so when somebody becomes overburdened——

Senator **Exon**. Was somebody watching when the possible wrong instructions were given at National the other day?

Mr. **Engen**. I do not know that possible wrong instructions were or were not given until we finally get into that. But yes, there was a supervisor watching there, yes, sir.

Senator **Exon**. Thank you.

Senator **Kassebaum**. At this time I believe Senator Ford has one more question for Admiral Engen.

Senator **Ford**. Well, Madam Chairman, it does happen to relate to the Administrator and I would like to ask just two brief questions if I may.

The first time you and I talked, Admiral, was prior to your confirmation, and we discussed the Air Canada situation as it related to the flammability of the inside of the aircraft. I was extremely interested, since they used Cincinnati Airport in my State for the site to land. And you were also very interested in aircraft crashworthiness at that time.

Now that you are in a different position, I would like you to explain what has been done in terms of flammability. If a similar accident occurred as it relates to Air Canada, would passengers have a better chance of surviving?

Mr. **Engen**. Senator Ford, I have not diminished my interest one iota and I still retain the strong biases that we discussed and it is overriding everything that I do as Administrator. We have indeed been moving ahead.

In response to the House, I have for the past year been providing a report at the end of every month, and just yesterday afternoon I signed out that report again to the chairman of the Aviation Committee.

Senator **Ford**. Did we get that report over here?

Mr. **Engen**. I will be glad to provide it to you.

Senator **Ford**. I think the chairman should receive it also.

Mr. **Engen**. I will be glad to provide it, of course.

[The following information was subsequently received for the record:]

U.S. Department of Transportation,
Federal Aviation Administration,
Washington, DC, September 30, 1985.

Hon. Norman Y. Mineta,
Chairman, Subcommittee on Aviation, Committee on Public Works and Transportation, House Of Representatives, Washington, DC.

Dear Mr. Chairman: This is the Federal Aviation Administration's (FAA) September report of the progress we have been making in meeting the proposed schedule of cabin safety regulatory actions.

Class D Cargo Compartment/Improved Liners: Notice No. 84-11B was published in the Federal Register on April 3, 1985 (50 FR 13226). The comment period closed June 3, 1985. Comments are being analyzed and work has begun on the FAA's proposed final action. We are on schedule in meeting our commitment to forward that proposed final action for Departmental and OMB coordination by December 31, 1985.

Protective Breathing Equipment: This document will include action on: (1) Portable Respiratory Equipment for Cabin Crews; (2) Improved Standard for Flightcrew Smoke Goggles; and (3) Hands-on Training in Fighting Typical Aircraft Fires. We are currently considering additional Departmental and OMB comments received regarding the costs and benefits of the proposal. We anticipate resolution of these concerns shortly.

Cabin Materials Flammability Standard: The Notice of Proposed Rulemaking Reopening of Comment Period on this issue, Notice No. 85-10A, was published in the Federal Register on July 26, 1985 (50 FR 30447). The closing date for comments was September 9, 1985. All comments are currently being analyzed. We anticipate meeting the commitment to forward our proposed final action for Departmental and OMB coordination by December 31, 1985.

Upgraded Medical Kits: The Notice of Proposed Rulemaking on this issue, Notice No. 85-9, was published in the Federal Register on March 14, 1985 (50 FR 10444). The comment period closed July 12, 1985. We are currently drafting the FAA's proposed final action. We plan to be ready to forward that proposed final action for Departmental and OMB coordination by November 21, 1985.

Passenger Seat Safety Standards: Proposed regulatory seat standards for rotorcraft, transport airplanes, and small airplanes have been forwarded for Departmental and OMB coordination. We are working to resolve Departmental concerns regarding the costs and benefits of the transport rotorcraft and transport airplane proposals. Advisory Circular No. 21-22, Injury Criteria for Human Exposure to Impact, was issued on June 20, 1985.

Proposed guidance material, in the form of four significant advisory circulars (one each for transport airplanes, small airplanes, and rotorcraft and one covering the use of analytic methods in impact dynamics) has been prepared. Notices of the availability of the advisory circulars have been prepared and will be published in the Federal Register concurrently with the proposed regulatory seat standards now in coordination.

Improved Flight Cabin Crew Emergency Communication: Work is progressing on a regulatory proposal to require public address systems to be powered by an independent power system in new aircraft designs. We anticipate forwarding FAA's regulatory proposal for Departmental and OMB coordination by December 1, 1985.

Evacuation of Smoke from Cabin: The work currently underway at the FAA Technical Center on in-flight test procedures for smoke evacuation. A notice announcing availability of a draft advisory circular addressing proposed test procedures and criteria for in-flight evacuation of smoke was published in the Federal Register on August 7, 1985 (50 FR 31991). Comments must be received on or before November 7, 1985.

Life Vest TSO: We are continuing the effort needed in the life vest area. One element of this effort in the revision to the TSO. A notice announcing availability of the draft TSO for public comment was published in the Federal Register on July 1, 1985 (50 FR 27083). Comments must be received on or before October 1, 1985.

An identical letter is being sent to Representative John Paul Hammerschmidt.

Sincerely,

DONALD D. ENGEN, *Administrator.*

Mr. ENGEN. But we have instituted fire-blocking layers for seats. We have come up with requirements for low-level light, low level being down low on the deck. We have required halon fire extinguishers in the galleys and lavatories, and we are adopting these new fabrics and things that will help prevent what has happened at Cincinnati.

Now, has it all been done yet? No, sir, it has not, and it is a continuing problem. At my technical center at Atlantic City, almost daily we conduct burn tests, and we are looking at fabrics and we are looking at qualities of things to improve and put in airplanes, and we are going to continue to do that, sir.

Senator FORD. Is it your responsibility as it relates to the safety of the airports itself, that is, the installation of the doppler system?

Mr. ENGEN. Yes, sir, it is.

Senator FORD. Somehow I do not get the right feel about this, and the feel I get is that it is going through the bureaucratic maze in order to get it to its final stage. And we are going to award, take bids in December and awards in 1986, and hopefully in 1992 we will get the system in.

Well, Cincinnati to me, as we just talked about, is a very important airport. Louisville is a very important airport. It is my understanding that they would be eligible for this system if we could go ahead and expedite the use of the system.

It seems like to me we have got a system that apparently works, or at least we have tested it in Denver and Memphis. And what you gave me for Dallas was nothing in comparison to the Doppler system, which gives it to you immediately. Is there any way in which you could expedite the system or this request for installation so that airports like Cincinnati and airports like Louisville and possibly Lexington could be in the posture of receiving this equipment?

Mr. **ENGEN**. Senator, if I could real quickly walk back, we first kind of identified wind shear in 1970. In about 1974, 1975, Dr. Ted Fujita of the University of Chicago developed the microburst theory and ALPA, ATA, pilot organizations, and we have all been working on wind shear over these last 15 years.

You asked is there not anything we can do to speed this up. We have not reduced the rate at which we are doing our research and development one bit. We are moving ahead, developing the technology to put that into place. We do not have that today.

Believe it or not, we do not have the algorithms, we do not have the software that will enable you to get a real time picture on a doppler weather radar that will be sufficiently accurate to forecast clear wind shear. We can do the heavy rain out there, but we are working on the clear air.

I was just this last week down at Memphis visiting Lincoln Laboratories, which is doing the work for us there. I went out to Olive Branch in Mississippi where we have the site, and we have made giant strides in defining what is required. Now, Sperry and Raytheon are working in head to head competition to further develop those algorithms and software.

They will provide the radars by the first of the year, January or February. There will be a head to head competition next spring and we will make that choice next fall. The funding for that will come in fiscal year 1987, and I am dedicated to trying to get that in as quickly as possible.

I did not address the terminal doppler weather radar, but that will be an adjunct to that, and I am trying to bring that along at the same rate.

Senator **FORD**. Thank you, Madam Chairman.

Senator **KASSEBAUM**. Thank you very much, Admiral Engen. We appreciate it.

Senator **EXON**. One last quick question before you leave. And maybe if you want to go back to this in our next hearing and give us a next little more information on it, fine. What is being done, if anything, Admiral, on what you and I have talked about and others have talked about for a long, long time? The FAA basically has been in support of it. Others do not seem to know much more about it.

I am referring to some kind of an airborne collision avoidance system around every airplane, which I recognize would cost some money. I recognize it is going to take some time to implement that. But I have never seen birds run into each other, and they fly in flocks. Is it not possible, is it not technically feasible, if we are talking about such things as strategic defense initiatives, that we might be doing something about installing on an airplane some kind of a device that says: There is something immediately ahead of you, that if you do not change your course in the next 30 seconds you are going to run together.

Mr. ENGEN. Senator, if you will permit me one bit of levity, I would like to take you out to Midway Island and let you watch the gooney birds out there. They sometimes run into each other on landing.

Senator EXON. Ducks do not. They are smarter birds.

Mr. ENGEN. Yes, sir.

And I think that TCAS, threat collision avoidance system, is what you are referring to, and I am not satisfied at the rate at which we the FAA are developing TCAS, and you will find me emphasizing this even more and more in the months to come. But it is one way to have an airborne capability to determine what is out there.

But to have that, you have to have mode C transponders in other aircraft, and there are a lot of other problems. But I am moving in that direction, and I am getting tired of going slow. I am going to try to go faster.

Senator EXON. Thank you, Admiral.

Senator KASSEBAUM. Thank you very much, Admiral Engen. We appreciate your testimony this morning.

[The statement follows:]

STATEMENT OF HON. DONALD D. ENGEN, ADMINISTRATOR, FEDERAL AVIATION ADMINISTRATION

Madam Chairman and Members of the Subcommittee, I appreciate having the opportunity to appear before you today to describe the status of the FAA's efforts in several key areas of express interest to the Subcommittee. I believe the way the Subcommittee has structured today's hearings so that key safety experts of the FAA and other segments of the aviation industry will appear together on panels provides an opportunity for a very meaningful dialogue on a variety of topical issues.

I am pleased to make available for today's panels Mr. Anthony Broderick, Associate Administrator for Aviation Standards, to sit on the panel dealing with the aviation safety inspectors; Mr. Neal Blake, Deputy Associate Administrator for Engineering, to site on the panel on weather radar; and Mr. Jack Ryan, Director of Air Traffic Operations, to sit on the panel covering air traffic issues.

Before discussing the specified topics of interest to the Subcommittee, I would like to briefly give my assessment of the overall status of our national air transportation system. In a word, I believe that our system is healthy. Certainly there is more that remains to be done to make it better—and we are all working to do that—but the fact is that our air transportation system is delivering what we expect of it; safe and efficient travel. When passengers board a U.S. air carrier, they are assured a level of protection afforded nowhere else in the world and by other means of transportation. They are paying for a comfortable and amazingly efficient way of moving vast distances in the span of mere hours—and by a transportation mode that has offered one million passengers a day the opportunity to select any of roughly 14,000 scheduled flights in the United States in which 99.999 percent of the flights will reach their destinations without incident.

I recognize and am highly sensitive to the concerns of the public—and, indeed, am concerned myself—about the recent accidents that have occurred both within and outside the United States. Let me assure you that we, in conjunction with the National Transportation Safety Board, are doing all that we can to see what problems occur and what measures can be taken to address these problems. Although more remains to be determined during the course of these accident investigations, I do think it is important to note that what we have seen this year indicates that there is not a common element shared in these tragic accidents. Therefore, their occurrence does not reflect a serious shortcoming or failure in the air transportation system itself which threatens the overall safety of that system. I believe that is a key point to note. Also, it should be noted that, despite the recent tragedies, the overall trend of accident and fatality rates has been a positive one which over the past decade has continued downward. And this is despite substantial growth in air travel.

So, in short, I believe that we can continue to have great confidence in the American air transportation system. I say that with some pride in the accomplishments that the FAA has been able to make toward the outstanding record of that system. At the same time, though, I must recognize the commitment and contributions of all segments of the aviation community toward constantly bettering the system. We must remember that the responsibility for assuring that the system operates safely does not rest solely with the FAA and the Congress. It is a shared responsibility. We can encourage safety in the air transportation industry; we can even prod operators toward following appropriate practices or punish them if they don't. But in the end, the overall record of our system will reflect the general commitment to safety of those who operate within that system. After all, the FAA, despite its best intentions and despite the best intentions of the Congress, will never have the resources to inspect every flight or to monitor every maintenance operation on an aircraft, and I don't want to imply that we should. Instead, a system of rules and procedures must be in place that, when followed, will afford a high degree of safety; and the FAA must work with the operators not only to see that the proper system is put in place but through surveillance and spot checking seek to ensure that it is adhered to. This is the appropriate balance that has been achieved within the aviation community over time. It has worked well and, in my view, it continues to work well.

Let me take a few moments now to briefly touch on those issues of interest to the Subcommittee.

WEATHER RADAR

The FAA has had an active program on wind shear since the early 1970's, when wind shear was identified as a cause of some aircraft accidents. Over time, we have come to learn much more about the wind shear phenomenon, its impacts, and how to detect it. As in most aviation issues, there are two key components to addressing the threat of wind shear: the human element and the hardware. In terms of the human element, we plan to award a contract to a consortium of aircraft manufacturers, airlines, and scientists for the development of an improved pilot training program on wind shear. This program will be conducted over a two year period and will provide a training program suitable for all categories of pilots. We expect that it will form the basis for better recognition of the wind shear phenomenon and help standardize the techniques for avoiding wind shear or minimizing its impact when encountering it.

On the "hardware" side, we have made substantial progress, in conjunction with the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Air Force, in what is called the NEXRAD program. This Next Generation Weather Radar was initially conceived to be a program which would meet the en route weather needs of the FAA, NOAA, and the Air Force as well as FAA's terminal weather needs. As we learned more about microbursts with resultant wind shear, it becomes clear to us that NEXRAD radar could not meet the FAA's weather needs in the terminal area where the threat of wind shear can be the most critical to arriving and departing aircraft. Therefore, FAA initiated development activities to establish the feasibility of using modified NEXRAD capabilities to meet the higher update rate and wind shear detection requirements of the terminal area, which constitutes the terminal Doppler element of our weather program.

System testing of the en route NEXRAD will start at the contractors' facilities in December 1985. Independent operational test and evaluation will be conducted through July 1986 and selection of the production contractor is scheduled to occur in mid-summer. Contract award is currently scheduled for November 1986.

The FAA has established a test bed for terminal Doppler weather radar at Memphis, Tennessee, to take data on microbursts in the humid southeast portion of the United States as recomended by the National Academy of Sciences. The test bed is also being used to determine the best siting and scanning strategies for terminal Doppler weather radar. It is currently planned to move the test bed to Huntsville, Alabama, next year to participate in the National Science Foundation project MIST (for Microburst Severe Thunderstorm). During 1986, the FAA, assisted by Lincoln Laboratory, National Center for Atmospheric Research, and others will develop and test automatic detection and warning algorithms for wind shear. In 1987, the FAA plans to conduct an operational test using the automatic detection and warning system. The site for the test has not been selected; however, Denver is one candidate being considered.

Development of alternative designs for a terminal Doppler weather radar is being initiated. Terminal Doppler radar would be a major system acquisition and we are currently looking at alternative ways in which to make the appropriate acquisition.

We are also continuing efforts on an airborne Doppler weather radar. The advantage of having a suitable airborne device is, of course, that an equipped aircraft would receive wind shear warnings at all airports at which it operates. Considerable technical problems which must be overcome include the ability to provide the needed sensitivities, clutter rejection, and automatic signal processing on an aircraft, where antenna size is limited and aircraft speed and antenna look angles required for low level wind shear detection accentuate the clutter removal task. Current airborne radar systems simply do not possess the needed capabilities. NASA Langley has proposed to initiate a research program to determine the level of improvement that could be achieved in airborne Doppler weather radar technology. The FAA is supporting this activity and we will keep looking, but there is no assurance that an airborne unit capable of detecting wet and dry microbursts can be achieved.

In short, we are making solid progress toward reducing the safety threat caused by wind shear through our programs which address both improved pilot training and the development of improved ground and airborne detection systems.

AIR TRAFFIC CONTROL SYSTEM

As the Subcommittee is aware, we have made substantial strides in rebuilding the air traffic control system. We attained our longstanding controller workforce goal of 14,000 for this Fiscal Year. In terms of our goals for operational controllers, we achieved 100 percent of the required opertional controllers at terminals and 82 percent in the en route option. Because of the lower numbers of operational controllers in the en route environment, we have incurred significant overtime usage at some air traffic control centers, but have programs in place now to improve that situation. Moreover, to better utilize our resources, we plan a major rebalancing in 1986 between the en route and tower controller options, and betrween facilities within each option. Through this transfer program, we intend to increase the percentage of full performance controllers in the center option.

Systemwide, we are operating at about 107 to 109 percent of pre-strike traffic levels. In fact, 5 terminals, 3 TRACONS, and 5 centers have posted an all-time record high for daily operations. We have also been able to handle this traffic without the high delays we encountered one year ago. To illustrate this point, I would like to compare our delay figures for January—August 1985 with the same months one year ago. This year, from January through August, en route operations increased by about 500,000 over the same eight months one year ago, which is about a 3 percent increase in traffic. We experienced about the same increase for the 22 pacing airports. Notwithstanding this increase in traffic, the number of delays over the 8-month period declined by 64,000 aircraft or 24 percent. For the summer months of June, July, and August this year, slightly more than 88,000 aircraft experienced a delay of 15 minutes or more compared to 124,000 in 1984. That is nearly a 41 percent improvement.

Also on the positive side, total operational errors are down this year over last year. They are down significantly in the en route environment, and up slightly in the terminals. During the months of January through August, we experienced 1,014 operational errors this year compared to 1,326 last year for the same period, which is about a 24 percent improvement over last year.

In terms of near midair collision (NMAC) reports, there has been an increase this year. But I should add that we have changed significantly our report handling procedures and emphasis, meaning that data for 1985 and subsequent years cannot be compared with 1984 and prior years. Preliminary data show that the number of NMAC reports filed through August have increased when compared with the same period last year. This increase has essentially involved general aviation and military aircraft, with the number of incidents involving air carriers remaining roughly the same as last year. A total of 530 preliminary reports were received for the first 8 months of this year compared to 392 reported last year during this same timeframe. I attribute much of the increase to renewed emphasis on pilot reporting and on improvements we have made in the FAA in our reporting system to obtain a more complete and accurate picture of what is occurring in the National Airspeace System. I would add that we are continuing our efforts to reduce the number of these incidents through an education program called "Back to Basics," which is being prepared for presentation to pilot groups and controllers throughout the courtry.

I understand the Subcommittee is also interested in knowing of our efforts to reduce runway incursions. This is an area which I have stressed within the FAA, and where I expect to see improvements in the future based upon a number of positive steps we are taking. I have personnally conducted two TELECONs with all of our towers to emphasize my own concerns about the need to prevent runway incursions. I did that in July. We have directed our air traffic managers to assure that tower facility managers conduct an analysis of local procedures which address runway crossings and, in particular, the coordination process between local and ground control. We are also strengthening controller training in this area, and are planning on initiating a human factors analysis of our tower cabs in November. We have an aggressive program in this area and intend to continue reinforcing in a variety of ways the need for constant vigilance to prevent runway incursions.

Before discussing the last issue of concern to the Subcommittee, I want to make one last observation concerning air traffic controller staffing. I have mentioned on a number of occasions that we continually review the level of air traffic controller staffing in order to assure ourselves that it is adequate to meet the anticipated demands on the system. As an outgrowth of our assessments of controller staffing needs, we now plan to increase our controller workforce in fiscal year 1986 by 480 people. As in the past, we will continue to monitor our staffing level versus workload demand, and make whatever adjustments are called for.

INSPECTOR STAFFING LEVELS

Another area in which we have been concerned about assuring that adequate personnel resources are available is in the air carrier safety inspector area. You will recall that Secretary Dole increased the authorized staffing for our air carrier inspector workforce by 25% in 1984, returning that complement of air carrier safety inspectors to its prior level of 674. Since that time, we have carefully assessed our inspector staffing and support needs with a view toward assuring that adequate numbers were available to fulfill our air carrier surveillance and certification needs. Based on those assessments, we have now determined that we should add additional aviation safety inspectors and support staff. To meet identified needs, and to add to our workforce at a rate that does not exceed our ability to absorb and train new inspectors, we are planning at this time to add an additional 150 aviation safety inspectors and support personnel over the next year. A budget amendment for these positions was approved by the President last week. We will continue to assess our inspector staffing levels with a view towards making whatever additional changes may be needed.

That concludes my prepared statement, Madam Chairman. Again, I appreciate having the opportunity to appear before you today, and welcome the opportunity to make FAA technical experts available to the Subcommittee.

[The following information was subsequently received for the record:]

Questions of Senator Exon and the Answers

Question. In a recent report on "Rebuilding of the Nation's Air Traffic Control System," the House Public Works and Transportation Committee outlined a number of recommendations related to stress, human relations, controller staffing, traffic volumes, and safety measurement. What is your reaction to this report and its conclusions and recommendations? What steps has the FAA taken to date to accomplish the Committee's recommendations?

Answer. Although the report was issued recently, it is based on data submitted and testimony heard in the period between May 1983 and June 1984. The report has little relevance to the air traffic control system as it is today. FAA witnesses responded accurately to the Committee's questions during the 1983 and 1984 hearings, but all too frequently the Committee chose not to accept the answers that were provided. The Committee's two major conclusions were 1) that the margin of safety is diminishing within the air traffic control system and 2) that the morale of FAA employees is low, and getting lower, due to stress, fatigue, overtime and non-routine work environment conditions, problems that are not being addressed in a meaningful way by the FAA. The agency disagreed with those conclusions then, and disagrees now.

The Committee's ten recommendations are based on a set of conclusions that the FAA does not accept. Consequently, there can be no question of implementing the recommendations. However, the FAA does have active programs to effect improvements in all five of the problem areas identified by the Committee: Stress, Human Relations and Communications, Controller Staffing, Traffic Volumes and Margin of Safety Measurement.

Question. Secretary Dole recently issued a press release announcing that she is committed to making our air transportation system safer. Other than announcing plans to hire additional controllers and inspectors, what specific new initiatives were announced in that press release of September 19, 1985?

Answer. Except as stated above in your question, Secretary Dole did not list any specific new initiatives during her press release of September 19, 1985. Her statement that the Department's essential task now "is to ensure that the controller work force is maintained at a level that will be fully responsive to present challenges" implies that we will continue to view staffing as a top priority.

Question. As mentioned above, the Secretary announced plans to hire 1,000 additional controllers. Will these controllers be hired in addition to existing efforts to bring in new controllers?

Answer. The additional controllers represent a net increase to the approximately 14,000 controllers and air traffic assistants that were on board in September 1985. The actual number hired over the next two years will be much higher, because we also have to replace attrition losses.

Question. Given existing attrition rates for controllers, how many of these 1,000 controllers will make it out of Oklahoma City? How many of these people does the FAA expect to be in the controller work force one year after being hired? How many will ultimately reach the level of Full Performance Controller?

Answer. To increase the work force by 1,000 we will need to hire approximately 2,030 developmentals. About 1,220 will graduate from the FAA Academy at Oklahoma City, and most of them will still be in the work force one year after being hired. Of the original 2,300, 900 can be expected to reach FPL status. These estimates assume an even mix of en route and terminal developmentals, and are based on attrition rates experienced since 1981. A new screening process which was introduced in October 1985 is expected to lower future attrition rates.

Question. During the hearing, Mr. Ryan referred to a new screening process for potential controllers. Could you please tell us what this new system is and secondly, how it differs from the old method of selecting and screening applicants?

Answer. Beginning with the FAA Academy class that started on October 23, 1985, students selected as ATCS's will no longer be assigned to the en route or terminal options. Instead, option and facility placement decisions will be delayed until the students have successfully completed the screening phase. Following the screening, the placement decision will be based on demonstrated performance in the screen, regional operational requirements, and the students' desire. Following the placement phase, students will enter into a training program designed to prepare them for field training and position qualification. This new approach is expected to better match potential to difficulty of facility, reduce field attrition, increase standardization, and generally reduce field training requirements. By better screening, placement, and training, we expect that safety will be enhanced.

Question. Much has been written in recent years about how airline deregulation, with its pressure on cost reduction, has contributed to a diminishing margin of aviation safety. Admiral Engen, what are your views on this matter? Do you believe that the pressures of deregulation are too great for what we believe necessary for airline safety?

Answer. I do not believe that competitive pressures and cost reduction, caused by deregulation, are inconsistent with airline safety. The regulations which define minimum safety standards for airlines are basically unchanged from these that were in effect prior to deregulation. When complied with, these regulations ensure airline safety in a deregulated environment. All airlines must comply with these regulations. So theoretically, all airlines meet the same safety standards today that regulated airlines met prior to implementation of the Airline Deregulation Act of 1978. Additionally, airline accident rate statistics do not support the contention that the margin of aviation safety has diminished since deregulation. The pressures of deregulation should not affect the regulatory baseline for airline safety. However, the FAA is vigilant, and we will respond to changes in the environment when necessary.

Question. As I mentioned at the hearing, I am concerned about the movement to have a controller at the radar screen 6 hours a day, as opposed to the four-hour shift formerly used. I continue to look forward to the figures you used in supporting your decision to make such a change, which you indicated you would supply to me.

Is this 6 hours on and two hours off an average for all towers and enroute centers, or a standard each controller must adhere to?

Answer. The change from about four to about six hours (actually six and one-half) on operational positions does not result in the controller being overworked. The prestrike average of four to four and one-half hours on position resulted from a situation of controller overstaffing rather than agency policy. The staffing standards in use at that time provided the staffing needed to handle the traffic levels that resulted in overstaffing during the other six hours. The one and one-half hours off position, interspersed throughout the 8-hour workday, is an average for both tower and center controllers. In practice, the time a controller spends on a position will vary from facility to facility and from day to day. It is affected by many variables such as the weather, the level of activity, the number of controllers actually available for duty on a given day, and the complexity of the position. The traffic peaks are now handled by a more sophisticated traffic management system, improved scheduling, and, when necessary, by the use of overtime. This six and one-half hours on position is not a standard that controllers must adhere to, but it is utilized in calculating the overall staffing requirements.

Question. Under this new work situation, how much training do controllers receive during their two hour down time? Will the reduced time mean a slowing of your efforts to achieve continued recovery of the air traffic control system?

Answer. The staffing standard allows approximately one and one-half hours per day for lunch and position breaks. This is free time away from the position. Training requirements are an entirely different calculation. The amount of training that a controller receives depends on the type and size of facility, any new or revised procedures, and individual needs. All receive refresher training in emergencies and seldom used procedures. The new staffing standards do not in any way reduce the amount of training provided or affect the speed of recovery efforts.

Question. It came out at the hearing that the FAA monitors work levels at both towers and en route centers to ensure that each controller is not overworked. Understanding that these standards vary from one location to another based on the level of activity, what specific standards do you use in establishing the proper amount of work per controller?

Answer. Because of differences among air traffic control facilities and even within individual ATC facilities, the FAA has not prescribed specific standards. Instead, the agency monitors and manages controller workload in two ways. These are strategic management of traffic and effective supervision.

The Traffic Management System (TMS) is a collection of programs which enhance our ability to forecast and manage air traffic flows, thereby, providing greater efficiencies in airspace usage and reductions of aircraft delays on the ground and in the air.

One of the major programs is the En Route Spacing Program (ESP). ESP is a program designed to smooth en route traffic flows by shadowing designated en route sectors to assist in ensuring spacing and reducing sector overload through inter/intrafacility coordination. In conjunction with ESP, other programs such as preferred routes and controlled departure times are used.

Each Air Route Traffic Control Center has designated certain sectors within their boundaries as having the potential to exceed an acceptable level of traffic during certain hours of the day. These sectors are identified as "red" sectors. Mandatory or preferred routes around these sectors were identified and are published/updated in the Airport Facility Directory. Since program implementation, less than ½ of 1 percent of all high altitude sector hours remain with the potential to exceed acceptable volumes of traffic.

The Controlled Departure Time progrm is designed to manage traffic during those periods when expected arrival demand will exceed an airport's acceptance rate. Delays are absorbed on the ground prior to departure to ensure that airborne holding and volume are kept at an acceptable level in both the arrival center's and terminal's airspace.

Additionally, first line supervisors are responsible for monitoring operational needs, through anticipation of traffic flows and initiation of various actions to effectively manage traffic, training and other operational requirements. Making position assignments, considering individual qualifications, proficiency, workload and available resources is a daily task. While supervisors maintain currency on required positions of operation, positive coordination/communication efforts on their part combined with constant monitoring of air traffic operations ensures that air traffic is maintained at a safe level.

Question. In the recent accident at Dallas of a Delta L-1011 aircraft, it has been reported that a weather service observer reported cloud formations that often are a prelude to major thunderstorms. Yet, that information was not immediately passed on by the controller to the Delta flight crew. Why not? What is missing in this type of situation that can and should be done to avoid possible recurrence?

Answer. Throughout different phases of the flight in question, the crew was provided weather forecasts and significant meteorological alerts concerning weather in the Dallas area. Eight minutes before the accident, a broadcast was made on the same frequency as the subject aircraft, advising of "a rain shower just north of the airport."

The weather report available to the tower controller indicated a scattered cloud condition, 11 miles visibility, with cumulonimbus type clouds north to northeast of the airport. Transmission of information concerning the presence of cumulonimbus type clouds was not considered pertinent as:

1. The cloud formations were clearly visible to flight crews.
2. No reports were received from previous aircraft penetrating this same area of weather that indicated the presence of unforecasted weather, and
3. The weather situation that existed at the airport was a typical summertime condition for Texas and familiar to pilots operating in that area.

The investigative facts presented in this incident indicate that in a few short minutes, cumulonimbus clouds on the final approach course built to an unpredictable explosive force. It is the pilot's responsibility to make decisions concerning the operation of his/her aircraft and we believe this responsibility is rightly placed. Should a pilot express a desire to avoid certain weather areas, it is incumbent upon the controller to assist as necessary.

Currently, we believe the best way of avoiding a possible recurrence of this situation is to initiate a pilot awareness program. Toward that end we have developed an Advisory Circular describing the hazards of wind shear which has been in circulation for a number of years. Additionally, the National Center for Atmospheric Research has, at our direction, developed two video tapes designed to increase pilot awareness of wind shear hazards. Our most recent effort consists of the awarding of a contract for the development of an authorative training aid for wind shear training. The contract was to an industry team. The industry team led by the Boeing Company, Lockheed, United Airlines, and Aviation Weather Associates should have this aid completed in early 1987.

In effort to improve our detection of wind shear at airports we have begun the development of an enhanced Low Level Wind Shear Alerting System. We have two prototypes of this enhanced system in operation at New Orleans and Denver and anticipate national upgrading on the LLWAS equipment by the end of 1987.

Question. Realizing stress exists in the controller workforce and that it can have a very debilitating effect on controllers, what steps are you taking to minimize its effects?

Answer. The FAA recognizes that stress is a problem among air traffic control specialists (ATCS) much in the same manner as it is with other occupational groups. Stress is also an individual condition in that not all controllers are stressed, nor do they all respond to the same stressors. Stress can be job related or may eminate from activities external to the job (such as family problems). Controller stressors differ from other occupations in that air traffic is a highly specialized, demanding, and nontraditional form of work. Stressors such as heavy air traffic, the need for immediate decisions, airspace configurations, etc., are different when compared to stressors in other professions, however, these differences do not mean that controller stress is greater than in other occupations. We do, however, recognize that it does in effect exist among controllers.

The FAA is dealing with the problem of stress in the following areas:

1. FAA-Wide Stress Management Program.—Recognizing that stress is a problem for all occupational groups, the FAA recently convened a national work group to identify the need and requirements of a nationally-directed stress management program. The proposed program has been sent out for comment to all FAA regions and staff agencies. The program can best be described as a preventive/interventionist program which would focus wellness through physical fitness, diet, support groups, etc., which would in turn enable employees to better deal with stress.

2. Guide for Identifying Distressed Employees.—We are currently working on the development of a training program to enable our supervisors and managers to identify distressed employees who may be suffering from job strain, personal problems, fatigue, substance abuse addiction, etc. This effort is exclusively for ATCS's and is separate from the proposed overall national stress management program.

3. Employee Assistance.—Employee assistance programs (EAP) are part of the authorities given to Federal agencies to establish health services to promote and maintain the physical and mental fitness of Federal employees. The FAA has established

EAP's in each of its employing jurisdictions. The program is structured to link troubled employees to those services best suited to assist them in dealing with their problems. Such problems may include alcoholism and/or chemical dependency, marital, financial, and/or other personal crisis. These services are available to all FAA employees and their families.

4. Traffic Management.—Job strain is a stressor created by heavy air traffic which can tax the controller's skills and abilities. While this situation may be viewed as challenging by some, it can be counter-productive to others leading to a feeling of fatigue. To minimize and or prevent this occurrence, the flow of air traffic is managed through the Central Flow Control and field facility Traffic Management Units. The key objective is a smooth flow of traffic to provide the controller with a reasonably predictable flow of traffic.

5. Participative Management.—Employee frustation because of a belief of not having a voice is an organizational stressor. To alleviate this frustration, there is an extensive air traffic employee participation group and communications network which has some 950 separate employee participation groups spread out over some 800 facilities. It is recognized that there are varying degrees of success with the different groups, however, the employee participation group process will continue to improve as it grows with and matures within the FAA.

6. Medical Support.—FAA medical personnel and Aviation Medical Examiners practice specialized medicine to treat the air traffic control population. A comprehensive air traffic controller health program is in place which monitors controller health and provides preventive medicine services.

7. Job Selection.—The FAA's medical program plays a key role in assuring that personnel applying for ATCS positions are capable of meeting the intellectual, psychological, and physical demands of the job. This is accomplished through the Multiplex Controller Aptitude Test (MCAT); The Air Traffic Control Occupational Knowledge Test (OKT); the Cattell 16 Personality Factor Test (which is used as an identifier of questionable cases who then are further screened via detailed psychological testing and psychiatric interviews); the physical examination and the psychological interview which is conducted as part of the physical examination. This process assists in the screening out of individuals susceptible to stress or anxiety. (OPI AAM)

Summary.—There are numerous stressors which affect controllers (and others) in a wide variety of ways. The above efforts represent an integrated attempt to mitigate/minimize the major stressors which can impact the controller work force.

Question. Please provide for the record, the total number of controllers now in place, both in control towers and at en-route centers. Within these figures, please identify the number of Full Performance Controllers, Developmental Controllers, and Air Traffic Assistants. In addition, please discuss the job responsibilities of each group.

Answer. As of December 31, 1986, the following numbers for controller staffing were current:

Center Controller Workforce	6,787
Tower Controller Workforce	7,191
Total Controller Workforce	13,978
The Center figures breakdown as follows:	
Operational Controllers	4,344
(Full-Performance Controllers included above)	(3,230)
Developmental Controllers	[1] 1,630
Air Traffic Assistants	813
Total Center Workforce	6,787
The Tower figures breakdown as follows:	
Operational Controllers	6,110
(Full-Performance Controllers included above)	(5,295)
Developmental Controllers	429
Air Traffic Assistants	652
Total Tower Workforce	7,191

[1] This number includes the Common Screen students at the Academy.

The following are the job responsibilities of each group:

Full-performance level controllers: These are controllers certified on all positions of operation within their area of specialization.

Operational controllers: These are controllers certified on two or more positions of operation within their area of specialization. They are able to contribute to the productivity of the system while at the same time are still undergoing training for advancement to the FPL stage.

Developmental controllers: These are controllers who are in various stages of training, either at the facility or at the Academy, and are working toward their certification on operational positions. At the time they become certified on two positions, they are considered operational controllers.

Air traffic assistants: These are people who work as assistants to the controllers and do basic paperwork and strip handling tasks.

Question. What are the number of controllers now eligible for retirement? What percentage do these people represent with respect to the total controller workforce? What contingency plans does the FAA have now for accommodating a possible mass retirement of these controllers?

Answer. *Retirement Eligibles:* December 1985 data showed some 2,769 center/terminal ATC's eligible for retirement. The retirement eligibles constitute 16.17 percent of the total center/terminal ATCS population of 17,124 personnel.

Actual Retirements: Over the past 3 years, retirements (center/terminal combined) have taken place at a rate of 14 percent of eligibles choosing to retire. The retirement pattern has been predictable and consistent with the average retiree being age 53 with 27 years of service. Following is the pattern for the last 3 calendar years:

CY 82, 317; CY 83, 331; CY 84, 401; CY 85, 438.

Attached is a yearly listing of retirements by month from 1982–1985. For 1986, we are projecting 490–500 retirements.

Contingency Plans: The FAA does not have a specific contigency plan to deal with possible mass retirements. This is based on the fact that retirements have been fairly predictable and consistent. At the present, we do not deem such a plan a necessity. We keep "on top" and monitor the retirement situation through a monthly report which reports the overall national rates as well as listing each of our centers and the 22 major pacing airport. Any shifts in retirement patterns are reported to top management for evaluation and/or possible action.

TOWERS AND CENTERS—MONTHLY/CUMULATIVE RETIREMENT ON ALL GS–2152 PERSONNEL [1]

Month	Calendar year 1985	Cumulative	Calendar year 1984	Cumulative	Calendar year 1983	Cumulative	Calendar year 1982	Cumulative
January	111		79		7		45	
February	34	145	33	112	32	39	25	70
March	49	194	45	157	28	67	31	101
April	30	224	43	200	37	104	26	127
May	36	260	27	227	33	137	37	164
June	33	293	40	267	37	174	26	190
July	22	315	23	290	21	195	20	210
August	31	346	21	311	24	219	19	229
September	24	370	24	335	14	233	23	252
October	9	379	12	347	18	251	10	262
November	12	391	17	364	17	268	8	270
December	47	438	37	401	63	331	47	317
	438		401		331		317	

[1] This listing does not include disability retirements as these data are used to project retirements based on reaching Civil Service Retirement eligibility. If disability was included for 1985, the number of retirements would be increased by 42.

Question. How many supervisors are continuing to work at controller positions? What are the average number of hours being worked at controller positions by supervisors?

MAJOR POINTS

Answer. 1. Supervisors are required to spend 16 hours per calendar month on an operational position to maintain currency. This would equal 10 percent of their time on position in a normal 160-hour work month.

2. We recently asked the regions to poll their facilities to determine how many supervisors were spending more than 20 percent of their time working on position. Twenty percent is a "reasonable amount" of proficiency time (even though our standard is approximately 10 percent) and we should not get overly concerned with supervisors working 10 percent thorugh 20 percent on positions.

3. The field data as compiled by the regions constitutes a "snapshot" in that not all facilities were polled and some presented the information as either a percentage or a raw number, but not both. The following "generalizations" can be made about center/terminal first-level supervisors.

a. Of 2,140 supervisors, 1,217 or 57 percent fall in the more than 20 percent category.

b. Center supervisors appear to be the most impacted. Their rate seems to range from 75 to 95 percent of supervisors in the more than 20 percent position time.

c. Terminals are less impacted. Their rates appear to average overall around 40 percent. While the overall average is 40 percent, there are some terminals where supervisors still work positions far above the average.

Question. What are the average number of hours of overtime being worked at both terminal towers and en route centers? What specific control towers and en route centers are currently experiencing staff shortages?

MAJOR POINTS ON OVERTIME

Answer. 1. The average overtime statistic is used as a measure of central overtime tendency and is calculated in the same manner as the arithmetic mean by considering the entire population in the air traffic control job series.

2. Situations of high individual overtime are monitored by facility managers.

3. The amount of overtime worked should not be studied in isolation when questioning its effect on fatigue. Other pertinent variables are:

Length of work day and rest periods provided during the work day. Period of the work day, and whether the workload is light, medium, or heavy. Length of rest periods between each work day. Length of the work week. Period of rest between work weeks. Physical environment. Each individual's subjective judgment of how much he/she can work. Overall health of the employee.

4. For the week of August 11–17, 1985, the following are statistics on actual hours worked (regular hours plus overtime, minus any leave hours taken) for center and terminal supervisory and nonsupervisory controllers.

Actual hours worked	Number of employees	Percentage
40 or less	14,654	86
Greater than 40 thru 48	2,132	13
Greater than 48	239	2

5. The overtime analysis is provided by biweekly payroll data that breaks down average overtime hours worked by air traffic controllers and supervisors with a separate break out for each. This information is taken from all air traffic field facilities excluding regional and headquarters Air Traffic staff personnel.

STAFF SHORTAGES

1. Presently there are no facilities experiencing staffing shortages. However, we have identified seven en route centers that have shortages of experienced full-performance level (FPL) controllers. Their staffing is at authorized levels, however, experience and training of these controllers will take time for both the center and terminal facilities. To help these centers, we have developed a cross-option program to encourage terminal facility controllers to transfer to the seven centers.

2. The seven centers are: New York; Cleveland; Indianapolis; Chicago; Minneapolis; Los Angeles; and Oakland.

Question. We have heard reports of efforts to unionize the current controller work force. What is the status of those efforts? Do you support or oppose such actions?

Answer. Several unions have attempted to organize the controller work force. Most activity took place during 1984. The American Federation of Government Employees petitioned the Federal Labor Relations Authority (FLRA) for recognition in an FAA region. The FLRA dismissed the petition, ruling that the unit was not appropriate and that the appropriate unit for air traffic controllers was nationwide in scope. That union has not been active in FAA for almost a year. At one time, the Airline Pilots Association (ALPA) announced it was interested in organizing controllers but recently decided not to pursue any organizing efforts. The Marine Engineer's Beneficial Association has indicated recently that it plans an effort to organize the controller work force.

As far as support or opposition to union organizing activities is concerned, the law prohibits either action on the part of a federal agency.

Question. In the summary report of the FAA's survey of its employees, only 53 percent of the respondents indicated satisfaction with their jobs. Generally, employee perceptions with respect to management's commitment to agency employees and managerial effectiveness in making organizational changes, organizing work, and improving human relations and working conditions were the areas identified as needing improvement. What has been the FAA's response to the issues raised by its employees? Aren't these concerns very similar to those expressed by the controller workforce in 1981 before the PATCO strike.

Answer. The FAA began immediately to use the July 1984 survey as a tool to analyze its strengths and weaknesses as well as its successful management programs and initiatives. Teams of managers went to three regions to interview over 800 employees at all levels and gain a more in-depth feel for the survey results. A few of the issues raised in the survey may be similar to those expressed by the controller work force on board in 1981, but we view the issues identified as being much broader and not limited to only one occupation. Survey data were broken down by region and center and each of these organizations prepared action plans to address the issues identified within their jurisdictions. We have developed a national process for follow-up by top management officials to evaluate the effectiveness of these action plans to address the issues identified. We do plan to conduct a second nationwide employee attitude survey in June 1986 to measure our overall effectiveness in bringing about change in our employee/management relationships.

Question. With respect to rehiring some former controllers to increase the experience level of the work force, you have said that that would be like mixing oil and water. Yet, a 1984 Task Force Report on Management and Employee Relationships indicated that 86 percent of the current controller work force did not mention this as a problem, and only 2 percent were against it. Why do you continue to oppose rehiring these people when you clearly have serious manpower and experience shortages and the existing work force seems unconcerned?

Answer. The only valid survey concerning rehiring controllers who struck against the United States Government was conducted by the Roper Organization, Inc., for the Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, House of Representatives. That survey showed that the controllers who honored their oath of office and remained on the job were overwhelmingly opposed to rehiring the strikers. The fact that employees at some later time did not volunteer a comment on an issue they were not asked about should not be construed as evidence of an unconcerned work force. Indications remain that there are still strong emotions concerning this issue among our supervisors and controllers who have performed so admirably during and since the strike. We do not intend to break faith with them on this issue. Moreover, we do not concur with the view that there are serious manpower and experience shortages. Certainly, more remains to be done in terms of rebuilding the system, but we remain confident of our ability to meet that objective in a safe and orderly manner.

Question. The Air Transport Association recently released a report expressing its interest in transferring responsibility for air traffic control from the FAA to a government corporation. At the time of the hearing, you said you had not yet had time to review this report. Given the addition time since the hearing, what is your reaction to such a proposal?

Answer. We have not completed a review of the proposal within the FAA, and in fact have asked the Air Transport Association for more detailed information regarding the Association's proposal. Given the far-reaching consequences which would result from the adoption of such a proposal, a careful analysis is required. In accordance with established procedures, any position we take on this proposal will be developed in coordination with the Office of the Secretary of Transportation and the Office of Management and Budget.

Question. The National Transportation Safety Board and many others are expressing increasing concerns about the rising number of runway incursions. What are you doing to eliminate these near-misses on the ground?

Answer. Throughout 1985, the various Air Traffic Divisions throughout the country have taken positive steps toward eliminating runway incursions. This effort has been from the lowest to the highest level of the FAA.

We started this effort by forwarding copies of several runway incursion incidents to all field air traffic facilities, for the purpose of educating air traffic controllers on how these types of errors can and do occur.

There have been several brainstorming sessions on a national level to formulate orders and changes to the Air Traffic Handbook 7110.65 to reduce the possibility of runway incursions. From these sessions have evolved a new FAA Order in Airport Operating Practices, and changes to Order 7110.65 concerning the local/ground control operation have been implemented. In addition, several notices have been issued from National Headquarters, mandating controller briefings and changes to operational practices to further reduce movement area incidents.

On July 24-25 and November 22, the Administrator personally conducted operational telecons with all towers reemphasizing the necessity to do all things possible to eliminate runway incursions. In addition, the Administrator attended the National Facility/Division Managers Conference in Philadelphia on October 9 to personally discuss the importance of eliminating runway incursions.

Although we have taken many positive steps toward eliminating these types of errors, we have not stopped in our effort. Presently, there are two major programs in process, one starting during initial ATC training at the Academy, to emphasize the total elimination of runway incursions; the other is the development of the Operational Position Standards Program designed to standardize control postions in the tower cab.

Question. One item discussed by many of our witnesses at the hearing focused on the need for an airborne Traffic Alert and Collision Avoidance System (TCAS). What is the status of FAA's rulemaking on TCAS? When will it be available? When will its use be made mandatory?

Answer. The TCAS family of airborne collision avoidance systems is designed to provide a back-up capability to the collision avoidance capabilities provided by ground-based ATC and normal pilot see-and-avoid procedures. The FAA has consistently stated that TCAS would not be mandated, but that voluntary equippage would be encouraged. Since TCAS will not be mandated, no rulemaking for TCAS is proposed.

The FAA plan has been to develop TCAS to a point where the U.S. aviation community can proceed with its commercial development. There are three categories of TCAS:

TCAS I—A system which generates traffic advisories only. TCAS I is designed for general aviation and air taxi useage.

TCAS II—A system which generates traffic advisories *and* resolution advisories (in the vertical plane only). TCAS II is designed primarily for airline use.

TCAS III—A system which generates traffic advisories and resolution advisories, which can be in the vertical or horizontal plane. TCAS III is also designed primarily for airline use.

The FAA has designed, built, and tested experimental equipment for each of these categories to develop engineering data for Minimum Operational Performance Standards (MOPS) which provides the technical basis for commercial development. In addition, because of the importance of airline TCAS equippage and the relatively advanced state of development for the TCAS II equipment, two additional efforts are underway to facilitate the commercial production of TCAS II:

1. A prototype TCAS II unit will be installed and flow on a Piedmont Airlines aircraft for eight months in early 1986.

2. In a cost shared contract with Allied Bendix Corporation and Sperry Dalmo Victor Corporation, 16 commercial quality units will be built and flown, beginning in mid-1987, on aircraft provided by United Airlines, Piedmont Airlines, and Republic Airlines. The flight test evaluation is scheduled for completion in early 1988.

A National Standard and MOPS have already been developed and approved for TCAS II. The development of MOPS for TCAS I and TCAS III is scheduled for completion in CY 1986.

Question. On September 24, there was a near miss between a helicopter and an Eastern Shuttle B-727, both of which had been cleared to takeoff from Washington National Airport. Since that day, it has been reported that some 20 controllers from National left work that day to play golf in Maryland. During the time they were gone, the near miss occurred. Can you verify the accuracy of this report? If it is true, were these controllers on annual leave with permission of their supervisor? Why was the supervisor on duty that day handling aircraft while trying to train a developmental controller? Who is at fault here and what are you doing to rectify it? How many controllers were on duty that day, as opposed to the staffing levels at the National Airport Tower prior to the 1981 strike?

Answer. The report that some 20 controllers from National Airport were permitted to leave the facility on the day of the incident to attend a golf event is accurate. However, the report that the incident occurred during the time they were out of the facility is totally inaccurate. The controllers who attended the golf outing left at 11:00 a.m. Their shift was scheduled to end at 3:00 p.m. The incident occurred at

5:22 p.m. on the evening shift. At no time was the facility understaffed in any respect, as outlined below.

The control tower was adequately staffed before, during, and after the incident. There are 83 people assigned to the Washington National Airport Traffic Control Tower and Terminal Radar Approach Control. Basically, they work in three shifts: 7 a.m. to 3 p.m., 3 p.m. to 11 p.m., and 11 p.m. to 7 a.m. On the night shift (11 p.m. to 7 a.m.), there are only two people on duty because there are virtually no night flights in and out of Washington National Airport during that time period. On the two day shifts, there are normally about 20 people on duty (3 supervisors and 17 controllers and air traffic assistants). One day each week, three teams work in a 24-hour period—two on the day watch and one on the evening watch. On the day watch, one team works operationally 4 hours while the second team conducts briefings and training. The two teams then switch assignments.

Once each year, a recreational outing is planned for the controllers in this facility. This has been done almost every year for some 20 years. It was not held for the 3 years immediately following the strike when staffing shortages would not permit. This event is scheduled in advance, and specifically on a day when all three teams are working in the 24-hour period.

On September 24, the team that worked control positions from 7 a.m. to 11 a.m. was allowed to leave the facility at 11 a.m. for the outing. (Had they stayed, they would have been undergoing training and team briefings rather than controlling traffic.) The were relieved by the other team who had been receiving training from 7 a.m. to 11 a.m. The staffing from 11 a.m. to 3 p.m. was 20 supervisors, controllers, and air traffic assistants—the normal level.

Thus, there is simply no truth to the assertion that the tower was understaffed when tower personnel were permitted to attend the outing. As earlier noted, the incident occurred at 5:22 p.m., and the normal tour of duty for the team at the recreational outing terminated at 3:00 p.m. They wre not expected to work the shift or time period in question.

At the time of the incident, there were 3 supervisors and 16 controllers and air traffic assistants on duty. There are seven operating positions in the tower, including the supervisor position. At the time of the incident, all positions were staffed, and training was being conducted on the local control position, which was being operated by a trainee under the direct supervision of the supervisor. The supervisor's routine administrative duties were being performed by the controller who had just previously worked the local control position and had been relieved by the trainee and supervisor. This type of supervisory check to evaluate training progress is standard practice at this facility. As you can see, the seven tower positions were technically occupied by eight persons.

There has been no assessment of individual fault in this incident; rather, the near miss was investigated, discrepancies noted, and corrective action taken in the form of remedial training and additional visual aids for pilots and controllers.

As noted, there were 19 supervisors, controllers, and air traffic assistants on duty at the time of the incident, which is normal staffing for this shift and day of the week. During pre-strike staffing levels, there were 21 supervisors and controllers on duty during a comparable period (week/day/shift).

Question. The FAA places the burden for following federal air regulations upon the airline, with FAA inspectors coming in to "check, monitor, and oversee," as you have stated. This approach was developed prior to deregulation, which has brought with it increased competition and the need for cost-savings. Do you believe that this approach is outdated under deregulation? Should the FAA consider changing this approach of safety self-compliance? If not, why?

Answer. We do not believe that this approach is outdated under deregulation or that it is in need of change. The improvement in accident statistics since deregulation indicates that FAA compliance procedures are working effectively.

Question. In December 1984, you were quoted as saying "I stand by my guns that the FAA now has sufficient inspectors." Admiral Engen, what made you change your mind? If we had had additional inspectors on the job in the past several years, do you believe any of the tragic accidents we have recently seen would have been averted?

Answer. Without concerning ourselves with the context of the quote, except to say that it was primarily addressed to adequacy of certification functions and not to the adequacy of surveillance, it is accurate to say that our estimates of the number of safety inspectors required to assure that the FAA has an effective inspection and surveillance program has been increased over the past year or two based on a number of studies conducted during this same period. The FAA conducted an in-depth review of the entire safety inspection program. In March 1984, the National

BEST COPY AVAILABLE

Air Transportation Inspection (NATI) was initiated by the FAA to assess the effectiveness of FAA surveillance and inspection procedures. In June 1984, an Aviation Safety Activity Functional Evaluation (Project SAFE) was initiated by the FAA to review and evaluate the effectiveness of our airmen and safety certification and inspection program. In July 1984, Aviation Standards initiated a General Aviation Safety Audit program to assess the effectiveness of FAA surveillance and inspection functions for general aviation. In June 1985, we determined the need for 500 technical and support positions for Flight Standards field offices, divisions, and headquarters.

No mathematical correlation between numbers of accidents and numbers of inspectors or inspections has been established, nor can we point to a qualitative relationship based on previous experience.

Question. Of the additional 500 inspectors, how many will be devoted to operations, maintenance inspections, and general aviation inspections? More importantly, how many of these personnel will be support staff and how many will actually be inspectors?

Answer. The breakdown of the 500 additional inspectors is:

	Air carrier	General aviation	Total
Operations Inspectors	68	98	166
Maintenance Inspectors	78	110	188
Support Staff			148
Total	146	208	502

Question. The General Accounting Office recently conducted a report showing wide variations in the numbers and types of inspections given to commercial airlines. For example, some 32 percent of all airlines had no avionics inspections during one 12-month period. What has been the FAA's response to this study? In your mind, is there any excuse for the types of variations that the GAO discovered?

Answer. The General Accounting Office (GAO) study covered the spectrum from a large sophisticated Part 121-Air Carrier to a small Part 135-Air Taxi. Some aircraft operating under Part 135 only require an annual inspection which includes avionics tests. This therefore explains the 12-month interval between avionics inspections. The maintenance requirements for large aircraft operating under Part 121 are very extensive and require sophisticated avionics tests. A more detailed analysis of a number of points which have been raised concerning the study is attached.[1]

Question. At the hearing, GAO witnesses also stated that the FAA was considering minimum standards for aircraft inspections. Is this true? If so, what are they? What standards are used now? Do they vary from region to region, or are they uniformly applied nationwide?

Answer. On October 1, 1985, the FAA implemented a system called the National Program Guidelines to assure that each air carrier will receive an appropriate number and quality of inspections.

The National Program Guidelines assure that each air carrier receives a minimum level of surveillance, additional surveillance will be scheduled as necessary. The guidelines also provide information to address staffing needs in a timely manner on a nationwide basis. The inspections, required by the National Program Guidelines, are uniformly reported on a computer data collecting system called Work Program Management System (WPMS). These new management tools will allow the FAA to respond to the rapidly changing deregulated environment on a "real-time" basis.

Question. The FAA recently fined American Airlines for a wide variety of maintenance violations, for a record amount of $1.5 million. Can we expect additional fines of this magnitude? Does this mean there are problems with the maintenance procedures at an airline such as American?

Answer. The FAA plans to conduct in-depth inspections of major air carriers during 1986. Should infractions of the magnitude of the problems uncovered at American Airlines reoccur, the FAA will aggressively apply sanctions to assure compliance with existing regulations. We do not believe that the problems uncovered at American Airlines indicate a widespread occurrence of similar problems.

---

[1] The attachment was not reproducible.

Question. Much has been reported in recent weeks about pressure from the Office of Management and Budget to consider an off-the-shelf radar system that may be less expensive than the Next Generation Radar System (NEXRAD), with its Doppler capabilities. What is the status of this review? If it has been completed, will the results change the manner in which the FAA proceeds on NEXRAD development?

Answer. A blue ribbon panel was formed under the sponsorship of the Department of Commerce to study the issue of whether a less expensive off-the-shelf radar system could be utilized to perform the NEXRAD mission. This study was finished in October and concluded that there are no off-the-shelf radar systems that could perform the NEXRAD mission. The study also recommended that the NEXRAD Program proceed without delay. The results of this study will not change the NEXRAD Development/Procurement Program.

Question. How has this OMB-imposed requirement to study alternatives at this late date slowed the timeframe for initiating the testing and production contracts, from those originally proposed by the FAA?

Answer. The delivery of the First Article Next Generation Weather Radars were not affected by the "off-the-shelf" radar study. The limited production contract award has been slipped from September 1986 to November 1986.

Question. What is the level of funding in the Senate FY 1986 appropriations bill for each of the following: NEXRAD, terminal Doppler and airborne Doppler research and development? What was the administration's request for funding for each program?

Answer. The level of funding is as follows:

RE&D FISCAL YEAR 1986

	NEXRAD	Terminal Doppler	Airborne Doppler
Congressional request	$1,895,000	$1,995,000	0
Senate bill	1,895,000	1,995,000	0

Question. You have stated that the FAA soon plans to implement a pilot training program on wind shear. When will that program begin? How many pilots will undergo this training each month? What will be the cost of such training to pilots? Has the administration requested funds for this program for FY 1986? If so, how much?

Answer. The Wind Shear Training Aid Contract was awarded November 29, 1985.

Once the 15-month period for the development of the wind shear training aid is completed, it will be offered as guidance material to all operators on a worldwide basis. In this manner, we would anticipate that all flight crews would receive this training.

This training when incorporated into an operator's training program would dedicate approximately ½ hour to 1 hour of additional ground school and/or simulator time to conduct this training each year for each crew. The cost will be absorbed by the air carriers.

Funds in the amount of $1.8 million are included in our proposed FY 1986 program.

Question. Nearly all parties testifying at the hearings strongly urged the FAA to push toward the development of an airborne Doppler radar system, or some equivalent, since current plans call for the placement of only 110 terminal Doppler systems. What is the status of FAA's work on such an airborne system? Will you pursue development of such a system, and if so, what timeframe have you laid out for research and development?

Answer. The FAA is in the process of implementing a National Integrated Wind Shear Plan (NIWSP) that lays the system framework for implementing the incremental improvements to the NAS with regard to wind shear.

A part of the systematic approach in the NIWPS includes "Flight Management Systems."

The FAA, in cooperation with the National Aeronautics and Space Administration, is developing a program to develop the technology baseline for "Airborne Wind Shear Detection and Avoidance" systems. The project objective is to provide the flight crew with reliable detection of hazardous wind shear in sufficient time to allow the crew to avoid the area. This program will lay the foundation for industry to manufacture certificable wind shear detection systems. The program is expected to take 5 years, with usable products for industry becoming available during that time.

Question. Low Level Windshear Alert System. You have stated that there is a Low Level Wind Shear Alert System (LLWAS) in place at the Dallas/Ft. Worth Airport. Assuming that it was operational at the time of the Delta L-1011 crash, why did this system not pick-up the wind shear that reportedly occurred on that day? Will the enhancements that the FAA has proposed for LLWAS be enough to detect microbursts and other types of wind shear at airports? If not, what more is needed?

Answer. The wind shear condition that is believed to have been a factor in the L1011 crash occurred off the airport beyond the range of the Low Level Wind Shear Alert System. The enhancements proposed by FAA for implementation in FY-87 and FY-88 will enhance the ability of the system to detect microbursts and other types of wind shears when they occur on the airport. Detection of wind shear conditions in the approach and departure areas around the airport will require installation of ground based terminal Doppler weather radars.

Question. Does the FAA have any intentions of combining NEXRAD research with work on the terminal Doppler system in the same contracting process? If so, what delays do you believe this will cause for the development and installation of the NEXRAD system?

Answer. There are currently two areas in which Next Generation Weather Radar (NEXRAD) and Terminal Doppler Weather Radar (TDWR) are combined in the same contract.

In the first of these, the NEXRAD contractors, Raytheon and Sperry, are performing a study of the changes required to allow a NEXRAD system to perform the TDWR mission. This information would be used in preparing a TDWR specification.

The other area of combined NEXRAD and TDWR research is in the Lincoln Laboratory contract. Lincoln Laboratory has fabricated and is operating a Doppler Weather Radar test bed which has the flexibility to operate either in a NEXRAD or TDWR mode. This facility is being used to support both efforts.

These research efforts will not delay the development and installation of NEXRAD.

The implementation strategy for TDWR is currently being developed. Possibilities included going competitive for the procurement or modifying the existing NEXRAD contract to provide for the TDWR. In the latter case we would not anticipate any impact on the delivery schedule of NEXRAD.

QUESTIONS OF SENATOR INOUYE AND THE ANSWERS

Question. My first question concerns the FAA's posture on the fundamental issue of individual passenger safety. If dramatic safety improvements can be accomplished for the safety of individual air travelers with a minimal cost per ticketed passenger in this country, would you concur that it would be your duty to see that such safety improvements are implemented? The type of safety improvements I am referring to are very fundamental issues such as: reducing the risk of explosion in a crash from the fuel on board, improving fire extinguishing equipment, protecting passengers against toxic fumes in the event of an in-flight fire, instructing passengers of what to do in the case of in-flight fires, improving weather reporting, and improving the air traffic control system to avoid midair collisions. I am not looking for a detailed answer on these specific issues, just the FAA's policy/philosophy of how to approach the cost effectiveness issue (i.e., are your cost effectiveness calculation directed at the individual cost to the passenger of improved safety, or are they directed at the cost to the industry of the safety improvement?) Is this what the philosophy has been over the past 30-40 years?

Answer. The FAA has an active aircraft safety program that has as its sole objective the improvement of occupant survivability. The major elements of the program are reduced inflight and post crash fire hazards, improved crashworthiness, and a number of miscellaneous improvements, such as tire integrity, turbine engine water ingestion, etc. With a safety record as good as that enjoyed by U.S. airlines, seldom can dramatic improvements in safety be obtained at minimal cost; however, in many cases the estimated cost of a safety improvement could be judged to be acceptable in light of the benefits gained by the increased safety. Most benefit assessments are analyzed in a manner to address the cost of implementation and any recurring cost to the party affected—manufacturer, airline, airport, etc. Even though the cost may be classically labeled an industry cost, in fact, any and all costs are paid by the ticketed passenger.

Generally, to weigh merits of a safety improvement and decide the course of regulatory action, FAA strives to assure that net cost of the improvements to society and the passenger will be equalled or exceeded by the net benefit expressed in dollars. The efficacy of this approach, of course, has limitations, especially in dealing with new safety technologies which can be readily assimilated but would not appear to be justified under cost/benefit criteria. In such situations, FAA conducts sensitivity studies of the improvement vis-a-vis accident statistics to gain economic perspective and answer such basic questions as to how much would the economic picture have to be improved to justify the improvement. Although expressing a safety improvement in terms of cost added to a passenger ticket might be considered as an academic aspect of research and development, FAA tries to avoid this in final regulatory decision making. This would tend to obscure total costs and benefits to society and would bear no relationship to benefits.

The FAA has exercised the above philosophy over the past several years.

Question. My next question concerns the statement often heard that it is "safer to fly than to drive." With all the airliners that have crashed in recent years, however, I wonder if this statement needs reevaluation. It seems to me that there are considerably more cars in this country than airplanes, and thus any comparison of fatalities in cars and airplane should take this into consideration.

How exactly are aviation fatalities statistically compared to motor vehicle fatalities? If possible, I would like to see statistics that compare aviation safety to safety in buses, trains, subways and ocean vessels. I would also like to see statistics which take into greater account the number of people transported and the number of vehicles or aircraft in the various transport modes, and the correlating fatality rates.

Answer. Yes, the number of accidents per million passengers for air carriers (includes air taxis and commuters) is 0.568 as compared to 118.321 and 562.167 for automobiles and buses. This measurement is an indicator of risk. Another indicator of risk accounting for time in travel is the number of accidents per million passenger-miles. For this indicator, the air carrier relative risk is 0.00062 as compared to 0.01227 and 7.63010 for automobiles and buses, respectively.

Motor vehicles fatality rate (0.00857) per million passenger-miles is approximately 28.6 times higher than the air carrier fatality rate (0.0003). NOTE: Bus transportation and Class I railroad fatality rates are 0.00130 and 0.09635. (Source: National Transportation Statistics, Document No. DOT-TSC-RSPA-85-5, June 1985)

Question. Along similar lines, I would like to discuss the FAA's definition of an "accident" compared to the public perception of it and the dictionary description of it as: "an unintentional and undesirable happening." How does the FAA define an accident? Also, how does the FAA define the word "incident," as it appears in "accident/incident" reports? I have been informed of many occurrences I would certainly term "accidents" or "incidents," but I don't see these occurrences in the accident/incident reports. Under what heading are these other occurrences such as aircraft being forced to return to the airport because of in-flight fires or smoke caused electrical shorts placed? Is it possible that aircraft can have an in-flight fire problem such as smoke generated from an electrical short that necessitates the pilot to return to his point of origin or land at another airport and yet not have it defined as an accident or incident.

Answer. Aircraft Accident—An "aircraft accident" is defined by the NTSB as "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until all such persons have disembarked, and in which any person suffers death or serious injury as a result of being in or upon the aircraft or by direct contact with the aircraft or anything attached thereto, or in which the aircraft receives substantial damage."

Fatal Injury—means any injury which results in death within 30 days of the accident.

Operator—means any person who causes or authorizes the operation of an aircraft, such as the owner, lessee, or bailee of an aircraft.

Serious Injury—means any injury which (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) involves lacerations which cause severe hemorrhages, nerve, muscle, or tendon damage; (4) involves injury to any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.

Substantial Damage—(1) except as provided in subparagraph (2) of this paragraph, substantial damage means damage or structural failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component.

(2) Engine failure, damage limited to an engine, bent fairings or cowling, dented skin, small punctured holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered "substantial damage" for the purpose of this part.

Aircraft Incident—An "aircraft incident" is defined by the FAA as "an aircraft occurrence, not classified as an accident, in which a hazard or potential hazard to safety is involved." It is important to note that many of the incidents have no identifiable operational factors involved, but are found in routine maintenance and airworthiness inspections. Most incident information is forwarded by the operator to the FAA for analysis; however, the NTSB does specify all type of incidents which must also be reported to them.

Your inquiry relative to an aircraft returning or diverting because of an inflight fire or smoke emission from an electrical problem would be an incident as defined by the definition.

Question. My next question concerns passenger and crew protection especially in regard to flight protection against smoke and toxic fumes. According to testimony presented in past Senate hearings, the Aerospace Industries Association reports that 90 percent of all aircraft fires occur inflight. I have information which indicates there may be as many as 600 such occurrences per year in this country alone; this in a U.S. fleet of only a few thousand aircraft. Even though these occurrences may vary from major to minor, 600 of them a year spread over a few thousand aircraft certainly seems like a significant number . Indeed, as a result of these accidents, many thousands of people have been asphyxiated due to inescapable smoke inhalation.

I am informed that pilots, by regulation, are provided 15 minutes of smoke protection. When was this regulation for 15-minute protection for pilots established and is it valid today? Is 15 minutes enough time for the pilot to get the plane safely on the ground in all cases? I also note that in airline safety announcements there is no briefing for passengers on what to do in the event of inflight fires and smoke. Is it your opinion that it would be appropriate to protect themselves in the event of such life threating emergencies? Further don't you feel that adequate protection should be provided for passenges in such circumstances as is provided for pilots? Are passengers and cabin crews' lives any less valuable than those of the pilots?

Answer. The statement that 90 percent of all fires occur inflight, that there have been up to 600 inflight fires per year in the domestic transport fleet and that many thousands of people have died as a result of smoke inhalation are not facts that are known to FAA. To obtain a figure like 600 per year one must nearly include every overheated circuit that trips a circuit that may generate smoke for a short time period. In fact, there are no documented deaths due to inflight fires aboard U.S. air carriers. If foreign airlines operating U.S. manufactured transports are considered then on the order of 500 fatalities have occurred over 10 years (i.e., Varig 707, Saudia L-1011, Air Canada DC-9). Inflight fires that develop into a hazard for the airplane occupants are in fact a rare event. That fact nothwithstanding, the FAA has and continues to explore concepts that can be implemented to decrease the potential hazards from an inflight fire. Examples of such improvements are more fire resistant seat cushions, cargo liners, interior cabin materials, hand held fire extinguishers, including the requirement for 2 Halon 1211 units, the requirement for an automatic extinguisher in each lavatory trash bin, and a smoke detector for each lavatory. Improved crew fire-fighting training and smoke evacuation testing are other safety improvements that will minimize inflight fire threat.

The requirement for a supply of protective breathing oxygen for 15 minutes is separate from the normal flight crew supply. The procedure when an inflight fire occurs is to immediately attempt to extinguish the fire and land the aircraft as soon as practicable. This basic edict to land the aircraft is significant since there always exist a potential that the inflight fire might not be controllable and landing will allow the occupants to evacuate the aircraft. The regulation also requires that an airplane be designed in a manner that will allow smoke to be evacuated from the cockpit rapidly. These capabilities and procedures have proven effective to date. Again, inflight fires when they do occur tend to be unique and in most cases, managed by the crew so that no generalized instructions are appropriate for the passengers, equivalent to the evacuation recommendations printed on the briefing cards. The cabin oxygen masks required for a decompression are available to the passengers should the pilot consider it necessary. The passengers are best served by having the crew combat the fire, descend and land as soon as practicable.

Question. Another issue I would like to address concerns medical kits. As you know, my colleague Senator Goldwater has for many years been a strong proponent of medical kits on board airlines. About 2 years ago we were assured by some of the airlines that complete and appropriate medical kits would be available on a limited number of aircraft, namely over-water flights. It is now 2 years later, and I would like to know if there are any medical kits on over-water flights for instance flights from California to Hawaii? If so, which carriers have them and has the FAA made it a requirement that such safety equipment be provided on the aircraft?

Answer. It is our understanding that United Air Lines has enhanced medical kits available on their flights from Seattle to Japan and Hong Kong. On March 14, 1985, the FAA published in the Federal Register a NPRM that would require air carrier certificate holders to provide medical kits containing equipment for use in the diagnosis and treatment of medical emergencies that might occur during flight. The period for public comment on this NPRM closed July 12, 1985. The FAA has completed its review of the comments, and issued a final rule January 9, 1986, requiring the carriage of additional items in the medical kits.

Question. I would also like to address current problems concerning the operation of aircraft in the airspace centers on two issues: wind shear and air traffic control to avoid mid air collisions. The recent Delta tragedy, and others in recent years, seem to indicate that we may not have proper equipment or personnel to permit operation of aircraft in hazardous weather conditions. If we do have the equipment and technology, then it certainly indicates we are not using it sufficiently. I am not a pilot, but this much I know; initial pilot training teaches pilots three things—make sure your plane is functioning properly before you take off, make sure you have enough fuel, and don't fly into thunderstorms. My concern is an ever increasing pressure on pilots and our system to maintain schedules despite obvious deficiencies in the equipment and procedures used to deal with these weather related circumstances. What are your views on this topic and what actions has the FAA taken to avoid this misplacement of priorities?

Answer. We do not believe that pressure to maintain schedules affects decision making concerning operations in bad weather. Pilots are trained to avoid weather conditions that adversely affect safety. However, the intensity of weather conditions is usually not fully known by either the pilot or the FAA controller. Thus, black and white decisions are not easily made. For example, if a pilot knew a thunderstorm, wind shear, icing, etc. was severe enough to be a safety hazard, he would proceed to another airport or runway. Airline company policies require such actions, and pilots are trained to carry them out. Likewise, if the controller knows the intensity of a weather condition has reached a hazardous level, his directives would require at least a change of runway or approach path. Unfortunately, real world circumstances do not always allow us to determine the intensity of weather conditions in all situations, but we continue to work toward that end. In the interim, we continue to ensure that airline training programs and policies teach pilots to avoid hazardous weather despite the demands of a schedule.

Question. In the case of air traffic control, there is an increasing traffic load and yet the pilots of these planes must rely on one or a few air traffic controllers on the ground to coordinate all the traffic. I was quite stunned to learn in testimony at Congressional hearings that before some of these problems—such as wind shear-are solved, we expect to have a few more crashes. In my opinion, the FAA should not support such a complacent philosophy—do they? If we are flying aircraft in conditions that are too hazardous, the FAA's philosophy needs to be made more safety conscious. I realize we cannot limit our air transport activities to only flying on sunny and clear days, but flying into the center of a thunderstorm is certainly unacceptable and must be stopped. What can you do to increase the pressure on industry to put safety a little further ahead of meeting time schedules?

Answer. The Federal Aviation Administration share the concern over wind shear and thunderstorm activity as it relates to flying safety. We can assure you that our philosophy on air safety is not complacent.

We use every available means to inform pilots of adverse weather conditions, including thunderstorms and windshear information.

In accordance with FAA policy and regulations, the pilot-in-command of an aircraft is directly responsible for and is the final authority as to the safe operation of that aircraft, including the decision to make an approach and subsequently land. We believe it is essential that this responsibility and authority continue to reside with the pilot-in-command since he/she is in the best position to consider all of the factors affecting the safety of flight. For example, the pilot is the only one able to consider such factors as the capabilities of the crew, the availability and effectiveness of onboard weather radar, and other operational capabilities of the aircraft. Because of the large number and varied types of aircraft and equipment in use, factors which might make landing or departing hazardous for one pilot/aircraft may be considered routine for another.

The FAA is continuing our efforts to educate pilots about wind shear. An Advisory Circular describing the hazards of wind shear has been in circulation for a number of years. Additionally, the National Center for Atmospheric Research has, at our direction, developed two video tapes designed to make pilots aware of wind shear hazard. Our most recent effort consists of the awarding of a contract for the development of an authortative training aid for wind shear training. The contract was to an industry team. The industry team lead by The Boeing Company, Lockheed, United Airlines, and Aviation Weather should have this aid completed in early 1987.

Question. Two other issues that concern me are the quantity of fresh cabin air per passenger and cabin pressurization. We have reports that indicate that potentially serious conditions exist in the passenger cabin or aircraft, particularly for people with marginal cardiac and respiratory medical status. Currently, there are certain fresh air ventilation rates which are prescribed for pilots for health and safety reasons including the containment of viruses, fungus, bacteria, disease and toxic smoke as well as evacuation procedures during an emergency. Should not the same criteria for health and safety apply to the passengers on board and the cabin crew? If so, why then is this not the case presently? Also, what is your opinion regarding the operating rules of the F.A.R. concerning cabin pressurization levels in relation to the potential risks of some air travelers?

Answer. The National Academy of Science is under contract to conduct an objective evaluation of all the cabin air quality concerns you questioned. It would be premature for the FAA to respond to your specific question until that study is completed and the findings are reviewed.

Question. My final questions concern the overall issue of airline safety. There has been widespread concern over the past several years that the FAA's actions have been reactive, rather than preemptive. I find this unacceptable as I believe the public expects and is entitled to a more rigorous approach to aviation safety. Indeed, given the uniqueness of the air transport system compared to other modes of transportation, it would seem to be paramount that the FAA be preemptive in its actions rather than learning from mistakes which can often be fatal. Other nations have been able to take an approach which is far more preemptively oriented. I am including in the record an article from Flight International magazine, which is a respected worldwide publication for the aviation industry, describing a safety analysis of the world's leading aviation nations. This study found that the U.S. is slipping seriously in aviation safety in relation to the nine leading nations. I find this fact disturbing. We produce more aircraft than any other nation in the world, yet our safety record is far behind other modernly-equipped nations. The Australians have a very admirable safety record, as do some of our neighbors on the other side of the Atlantic. Qantas, I am told, has not lost a single life in a crash in its 50 years of operation. Should we not confer with the Australians and other nations to learn what it is that they are doing right and we are doing wrong?

In recent testimony presented by the FAA, there was open admittance that more crashes are expected in the U.S. this year before we get various problems corrected. I find this terribly wrong. Can you inform this Committee of some substantive approaches that will provide policy and direction for the agency to put us at the top of the safety list instead of the bottom?

Answer. We believe that many of our recent actions are, in fact, preemptive and should have a positive influence on safety statistics. For example, national work program guidelines have been implemented in October which establish minimum levels of specific surveillance that must be accomplished on individual carriers. Additionally, regulatory projects pertaining to flight and rest requirements, security, cabin safety, and crewmember training have either been completed or are underway. Further, the National Air Transportation Inspection (NATI) completed last year and the General Aviation Safety Audit (GASA) inspection currently underway are examples of major efforts undertaken by the FAA that should be considered as preemptive actions. Notwithstanding these preemptive activities, we should always recognize that if and when errors are found, preemptively or reactively, they should be corrected. Learning from any mistake, fatal or otherwise, is far preferable to ignoring its existence and is a mark of a progressive attitude that should be encouraged concurrently with a rigorous and indepth monitoring of the industry to allow recognition of the necessity of preemptive activity when appropriate.

In reviewing the Flight International article we are not in full agreement with the magazine's conclusions but do fully support the suggestion that conferring with other nations on safety matters is a meaningful process. This type of exchange of safety views and procedures is ongoing through international forums such as ICAO, and we have every intention of using these meetings to learn what other nations are doing and to take their ideas and use them when appropriate.

The actions mentioned above along with the recently announced plan to hire an additional 500 inspectors should serve to improve the overall aviation safety environment. Inspector training is being upgraded and we are working closely with all segments of the industry to achieve our commitment to aviation safety. We believe that U.S. aviation is and will remain the safest mode of commercial transportation in the world.

Senator KASSEBAUM. Our next witness is the Senator from Pennsylvania, Mr. Specter, who was a passenger on a plane recently which I believe was a near miss.

STATEMENT OF HON. ARLEN SPECTER, U.S. SENATOR FROM PENNSYLVANIA

Senator SPECTER. I believe so, too, Madam Chairman, but some may question that. But it is the reason that I asked for a few minutes to testify this morning as a fact witness.

Last Thursday I was returning on a flight from Scranton/Wilkes-Barre on a Brockway Commuter Airline to National Airport and there was a situation where, as reported to me, a plane came across the path where my commuter was supposed to land, causing my plane to take evasive action, to lift up again and circle the plane.

And I promptly wrote to Administrator Engen about it and drafted a letter to you suggesting hearings by your subcommittee, and was delighted to find that you were already scheduling this hearing for today. So I of course did not write to you, but did ask leave to appear here.

And since then I have had some conversations, my staff has, with representatives of the Federal Aviation Administration which lead me to some real questions about the reporting procedures, the seriousness of the incident that was involved with my plane, and really what is being done about it

And the specifics are that the Brockway flight was a small commuter flight, was coming in to land at National Airport right around noontime, and it was a small enough plane so that when I was seated on the left-hand side, which I believe had a single row of seats, I could look to my right and have a view of the landing strip coming in, so that I saw the descent.

And I saw that we were very close to the ground. Precisely how close we were I do not know, but I was later told by the pilot that we were within 200 feet of landing. It seemed to me that we were closer than that, but I am not a pilot or an expert, so I could not say with any more certainty.

But I know that we were very close to landing, and suddenly at the last instant the plane took on power and lifted off and went into a circling pattern in very heavy fog, pea soup from my point of view. So when I came down, after having missed a vote, I might add, I wrote to Administrator Engen saying that: "At approximately 12 noon today, when I was arriving at Washington National Airport on Brockway 42," and I described to him what happened and I asked him for answers to some specific questions:

No. 1, what caused the confusion in the landing today? Secondly, how many such occurrences have there been like this? And third, how many other dangerous situations like this one or the Eastern incident had occurred? The Eastern incident, of course, was earlier in the week and it caused a tremendous amount of publicity, and nothing appeared anywhere in the news media to my knowledge on the Brockway incident.

And to this moment, I do not know with certainty the degree of seriousness about it. It was reported to me that there was a plane perhaps at the very other end of the runway, perhaps some 5,000 feet away. That may or may not be true. If so, it certainly did not appear that way to me as a passenger.

It has been further reported to me that there has been some confusion in the signs at National about where planes go into off ramps or to runways. There is construction; there may be some signs which are mislabeled.

I call it a near-miss, Madam Chairman, as you do. I have been told by the experts that I should not use that term because it was not a near-miss, and that raises a question in my mind as to what category is used for the term "near-miss." I will tell you, from a passenger's point of view it sure felt like a near-miss to me, and if it is not a near-miss I wonder what it is. And if it is not categorized as a near-miss, I wonder if a great many incidents ought to be categorized as near-misses, which are not being categorized as near-misses to make the statistics look better.

And how serious it was I do not know, but I thought it worthy of calling to the attention of this subcommittee. And I have an instinct as a factfinder, as a litigator, that we ought to be taking a close look at the categorizations which the FAA is using as to what has happened.

And I hope it was not serious, but I have a sense that it was. I certainly was very uncomfortable going back up. You really wonder about all the traffic at National, when you take an unexpected elevation, as to how they know who is coming in. They do not anticipate a plane going up, or maybe they do. Maybe they are ready for every plane to go up. Maybe it happens all the time, but I prefer not to be on board.

Senator **Kassebaum**. Well, it always leaves a passenger feeling uncertain, I think, Senator Specter, when all of a sudden one gets the sensation that a course reversal has occurred with no knowledge as to why.

In this particular instance, was there another plane involved?

Senator **Specter**. Well, the pilot told me there was another plane involved. He said that he saw another plane coming onto the runway.

Senator **Kassebaum**. Was he asked by the control tower to "go around"?

Senator **Specter**. He said he was asked by the control tower to abort the landing, which he said he would have done had he not been so instructed. I did not ask him, had he started to abort the landing prior to the instruction or not. My sense was that he probably had, but I do not know.

Senator **Kassebaum**. I think there are many instances when a go-around is ordered and for some reason the pilot must make some adjustments. I think perhaps this is where—and I am no expert—the FAA would make a determination as to whether or not it was a near-miss or whether indeed it was a situation in which the flight pattern had to be changed and evasive action taken.

As to whether this shall be characterized as a near-miss is a question for the experts who will testify later.

Senator SPECTER. I do not know whether it ought to be classified as a near-miss, but I think it is a dangerous situation. I think the conclusion of a dangerous situation arises, obviously, from the fact that the landing was aborted and that there was some danger present. How much, I do not know.

But there ought to be a category which reflects that, and there ought to be a way of making a point short of being a U.S. Senator and being able to walk into a hearing at will because you know the chairwoman.

Senator KASSEBAUM. Well, I suppose there are a lot of passengers who wish they could do this. You are speaking for many who have been on a flight that has suddenly climbed steeply, or dropped, and wondered what has happened. We know more and more today, indeed, about the technology, and I think more passengers are better informed today about what goes on. But that does not diminish the need to follow through.

Are there any other questions?

Senator EXON. No other question. I just want to say that I am very pleased, Senator Specter, that you took the time to come over and give us your firsthand testimony. I have heard of other similar events and it is part of our oversight responsibility to make sure that we have all of the information. I appreciate your taking the time to come over and tell us about your personal experience.

Senator SPECTER. Thank you, Senator Exon. I share your concern in one of your earlier questions about what happens with commuter airways. We are all on them all the time, and so many Americans travel on them. There really is a heavy responsibility to see to it they are as safe as they can be.

Madam Chairman, I would like to have a copy of my letter to the Federal Aviation Administrator made a part of the record. And I would like to make the request, if it is consistent with your policy, to have your staff review it and see what the answers are to just precisely what happened. My staff will pursue it as well, but I would like to know whether it was 5,000 feet away or whether it was a near-miss and just how those categorizations are made. I can pursue it myself, but I would ask that it be made a part of the record.

Senator KASSEBAUM. Thank you very much, Senator Specter. It will be made a part of the record and we will follow through. We appreciate your coming.

[The material referred to follows:]

U.S. SENATE,
Washington, DC, September 26, 1985.

Mr. DONALD D. ENGEN,
Administrator, Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC.

DEAR ADMINISTRATOR ENGEN: At approximately 12 noon today when I was arriving at Washington's National Airport on Brockway Flight #482, our plane was 200 feet from the ground when it suddenly accelerated and circled the airport again because a jet was crossing the landing strip where our plane had been directed to land.

When I asked the pilot about it after we did land, he said that our plane was about 200 feet above ground when the jet came across its path. In light of this incident and the incident earlier this week involving the Eastern airliner, I would very much appreciate your advising me promptly about the following:

1. What caused the confusion on our landing today?
2. How many such occurrences have you had within the past year like the one involving my plane today?
3. How many other similarly dangerous situations have arisen in the course of the past year involving near crashes like the Eastern incident or the one involving my flight today?

Sincerely,

ARLEN SPECTER, *U.S. Senator.*

Senator **KASSEBAUM**. The next witness is the Honorable James Burnett, Chairman of the National Transportation Safety Board.

It is a pleasure to welcome you this morning, Mr. Burnett.

STATEMENT OF HON. JAMES BURNETT, CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD

Mr. **BURNETT**. Thank you, Madam Chairman, members of the subcommittee. I appreciate the opportunity to join with you in the discussion of aviation safety.

There is no question that the events of the past few months provide ample cause for concern, and you are to be commended for providing this forum to assure that the public is fully informed on what is taking place within our national airspace system. In addition to my appearance, Madam Chairman, the Safety Board has provided three representatives, one for each of your panels.

Despite the fact that the aviation industry has enjoyed a remarkable safety record, the statistics indicate that 1985, in terms of lives lost aboard U.S. airliners, is the worst year of the eighties and the third worst year of the past 10, and we are only 9 months into the year. So far we have had 19 accidents involving U.S. commercial air carriers, 6 of which have been fatal, resulting in the loss of 270 lives.

The picture is even more distressing with the addition of foreign carrier accidents, the most notable being the Air India 747, the Japan Airlines B-747, and the British Air Tours B-737. These three accidents alone took over 900 lives.

It is important to note that the most serious of these accidents, at least the most serious of them do not appear to have a common denominator. Although nearly all the accidents remain under active investigation, the findings so far indicate that the factors involved are varied, including weather, mechanical failures and operational errors.

Some of the accident circumstances appear to be sufficiently unique that we have to view them as isolated events. The Air India and Japan Airlines accidents seem to fall into this category. Others, regrettably, illustrate aviation safety problems which have been addressed repeatedly as a result of past accidents and incidents.

An incident which took place 1 week ago today at Washington National Airport points up a continuing problem with air traffic control communications and procedures. The pilot of an Eastern Airlines B-727 shuttle was forced to reject his takeoff after reaching takeoff speed to avoid a collision with a helicopter which had also been cleared for takeoff just seconds earlier by a different controller on a different radio frequency.

Fortunately, the pilot of the 727 managed to bring the Eastern jet to a stop in a safety area beyond the runway without injury to passengers. The helicopter pilot also perceived the pending collision and altered his course. We are examining the coordination between the two controllers, their training and the clarity of communications with the helicopter as factors in this incident.

The Safety Board has become increasingly concerned about the continuing occurrences wherein airplanes nearly collide with other airplanes or vehicles which cross the takeoff or landing path. We have investigated over 20 such incidents during the last 5 months.

In several of these there was a breakdown of communications between two controllers, both of whom were in the control tower cab. We are conducting a special investigation of these incidents to identify more particularly the factors which have contributed to deficient controller coordination or pilot errors which can result in dangerous runway incursions.

Our concern about another air traffic control problem—the potential for aircraft collisions during flight—was emphasized most recently during deliberation on the report on an accident which occurred in August 1984. This occurrence involved the collision of a commuter airplane with a general aviation airplane as the commuter was departing the San Luis Obispo Airport in California. We noted that this might have been prevented if the commuter plane had been equipped with an air collision avoidance system.

We recommended years ago that the FAA support the development and implementation of an airborne collision avoidance system for all civil aircraft. The objective of a collision avoidance system is to provide a practical and effective backup to other aircraft separation assurance procedures and systems to reduce the potential for midair collisions. Collision avoidance systems are intended to warn pilots about potential collision threats and in some systems provide avoidance advisories for both horizontal and vertical maneuvers.

The Safety Board believes that any required research work, operational evaluation, or other needed developmental effort should be expedited so as to facilitate implementation of a collision avoidance system at the earliest possible date. Further, we believe that the FAA should evaluate its intentions not to impose a requirement for TCAS in large aircraft used in air carrier service. The effectiveness of TCAS in the prevention of midair collisions will not be realized until the systems are in widespread use, and that most likely will occur only through regulation.

The Delta Airlines L-1011 accident in Dallas in early August serves as a tragic reminder that yet another persistent aviation safety problem—wind shear—remains unsolved.

The hazard that a wind shear, particularly the microburst variety associated with a thunderstorm, presents to a jet transport airplane during its takeoff and landing was recognized and acknowledged during 1975 after the crash of a Boeing 727 airplane inbound to JFK Airport that cost the lives of 113 people. That accident occurred when the airplane encountered the winds and rain associated with a thunderstorm on final approach.

Since the investigation of that accident, the Safety Board has issued over 30 safety recommendations addressing the need for both ground-based and airborne equipment for detecting wind shear, the need for improved weather communication procedures, and the need for better pilot training programs.

We recognize that some of the actions needed to achieve an ultimate solution to the wind shear hazard involve advanced technology and require continuing research and development. Nevertheless, we find it extremely frustrating that other actions have not been taken.

For example, the low level wind shear alert system, or LLWAS, originally was designed to detect a gust front as it crossed the airport. However, about the same time LLWAS was being installed at many airports, the microburst was identified as the most severe wind shear hazard, and yet there was little if any effort expended to determine how best the LLWAS could be used to counter the microburst threat.

Flight crew training is another area in which immediate improvements can be made, although some accomplishments have been made. The major airframe manufacturers have produced literature about the wind shear threat, including the importance of avoidance, as well as well as recommended piloting techniques to cope with inadvertent encounters. Most of the airlines have an active wind shear training syllabus which includes flight simulator demonstration of wind shear encounters.

However, some flight crews still are not receiving the quantity or quality of training needed. We strongly support FAA actions to require carriers to develop a more comprehensive training syllabus.

The Safety Board continues to support the Next Generation Weather Radar Program, Nexrad, with the wind measuring capability of microwave doppler radar. The Nexrad implementation will improve en route weather detection and avoidance.

We anticipate, however, that it will not be a significant factor in the terminal area wind shear problem. In other words, the crashes that we are having caused by wind shear will not be avoided by the Nexrad system. Therefore, we believe that the FAA has to pursue a priority program to purchase doppler radar for terminal areas while it pursues the research and development programs needed to automate the radar data into an operationally useful product. Even with an expedited program, we think that the earliest operational use of terminal doppler radar is 3 to 4 years away, and that is optimistic.

My final area of discussion involves the Safety Board's review of the adequacy of the FAA's Air Carrier Surveillance Program. Our ongoing concern in this regard was heightened as a result of three 1983 air carrier accident investigations.

The first involved the complete loss of power on all three engines of an Eastern Airlines L-1011 during a flight from Miami, FL, to Nassau. A serious accident only narrowly was avoided when the flight crew finally restarted one of the engines following a lengthy, unpowered glide toward Miami and successfully landed the airplane.

The investigation disclosed that the lack of effective FAA surveillance of the carrier's maintenance functions was a contributing factor in the accident because the FAA's maintenance inspectors failed to assess the significance of previous incidents in which improper installation of master chip detectors in the engines resulted in engine shutdown due to the loss of lubricating oil.

Another accident involved a Sierra Pacific Airlines deHavilland Dash-6 commuter flight at Hailey, ID. The plane was on final approach when its elevator control linkage became disconnected, depriving the pilot of vertical control. Both pilots and five of their six passengers were seriously injured in the crash landing.

The Safety Board investigation revealed that Sierra Pacific maintenance personnel had installed an improper bolt and had not secured it. The carrier's maintenance director had supervised both the maintenance work and the inspection, mingling the two functions to the point that an inspection that would have disclosed the improper bolt was never performed.

The same lack of separation was found by the Board in its investigation of the nighttime crash of an Air Illinois HS–748 airliner en route from Springfield to Carbondale, IL. The flight crew did not turn back to Springfield when all regular electric power was lost a few minutes after takeoff, but continued toward its destination some 130 miles away.

The flight crashed at Pinckneyville, 25 miles short of Carbondale, the airline's maintenance base, when emergency battery power ran out and flight instrument references were lost. All 10 people aboard were killed.

Although the failure to divide maintenance work and inspection was not found to be a factor in the accident, investigators did find this problem at the Air Illinois base. Testimony at the public hearing also disclosed pilots' routine failures to log mechanical irregularities after flights—a practice that the Board said should have been detected and corrected by FAA inspectors checking Air Illinois maintenance.

Alarmed by the apparent lack of quality FAA surveillance in these and other instances, the Safety Board in the fall of 1984 approved initiation of a safety study on the effectiveness of FAA air carrier surveillance.

Madam Chairman, all of us associated with the aviation industry have a responsibility to assure that the excellent safety record amassed by the air carrier industry since its inception is continued. To accomplish this, we must reduce the potential for aircraft collisions resulting from ATC errors, we must acquire the capability to detect and avoid the wind shear hazard, and we must make sure that our aircraft are well maintained and the flight crews are trained to perform competently and professionally. With the cooperative diligence of the Congress, the industry, and the regulators, I am confident these goals can be accomplished.

Thank you for this opportunity to share the Safety Board's views, and I will be happy to answer any questions you may have.

Senator KASSEBAUM. Thank you very much, Mr. Burnett.

First I would like to compliment you and the Board. I think you have done, during the time that I have followed your involvement in aviation, an exceptionally fine job in monitoring and calling attention to accidents and safety factors. And, you have done that despite operating more-or-less at half-mast with a Board that is not complete.

I would like to go back to a complaint that I have often heard through years of subcommittee testimony: That NTSB makes recommendations and no one really pays any attention. Take wind shear, for instance. You mentioned investigations and recommendations which you made in this area in 1975. Is that correct?

Mr. **Burnett**. That was when we initiated our activity in that area.

Senator **Kassebaum**. Regarding the need for equipment that could better detect such a weather phenomenon.

Now, I think most authorities agree that it would take at least 5 years to install an airport terminal Doppler wind-shear detection system, at a cost of about $4.5 million per airport.

If such a system had been seriously considered at the time you made your recommendation, we would have it in place today.

Do you in any way fault either OMB for being somewhat parsimonious with the purse, or FAA for not aggressively implementing recommendations regarding NTSB?

Mr. **Burnett**. Well, I think when we first made our recommendations, the FAA moved forward with the research and development program, and it did require research and development. This was not something that could just be bought.

Senator **Kassebaum**. This was in 1975?

Mr. **Burnett**. This was in 1975. Unfortunately, I think they lagged somewhat in that effort because we had about 5 years there, from 1977 to 1982 when we had the New Orleans crash, in which there were no wind shear accidents, despite the fact that we have averaged over one a year since 1970. There was a period there for some reason in which there were not any, and the attention on this issue somewhat refocused on perhaps other aviation issues.

We have felt that in recent years, since 1982, and perhaps even before that, the FAA has moved forward as quickly as circumstances would permit them to do.

We know that there is some disagreement between the FAA and others in the budgetary process about the development of the Terminal Doppler Radar Program. They chose first to develop Nexrad and to piggyback the Doppler radar onto that. Whether that was a good choice of priorities, I think we could raise questions about it. It would be a close call.

The problem now with the terminal Doppler radar is that they still have not done all the research and development they need to do on the software to make the Doppler radar information usable by the air traffic controller. He is not—the air traffic controller is not a radar meteorologist, so he has to have some software to interpret that and to give him some sort of alarm, indication that he has a problem so that he can then advise the flight crew what to do, and that software has not been developed, and there is still quite a bit of work to go on that.

So the disagreement is some saying let's not invest money in the Doppler radar until we have the software designed, we know what we are going to do with it, and others—and this is the position that the Safety Board would take—is that we ought to go forward with both forms of development concurrently in order to speed the time when we have this.

Now, I think there are some legitimate arguments on the other side, but the fact is the additional time that it will take if we wait to develop the—to actually purchase and install the Doppler radar until we get the software designed will mean that we will lose some aircraft to wind shear because of that delay.

Senator **Kassebaum**. We are doubling the low level wind shear alert systems, however, are we not?

Mr. **Burnett**. Yes, and that is a good thing. However, we have not made the progress we should have in the use of the low level wind shear alert systems.

Senator **Kassebaum**. How do you mean?

Mr. **Burnett**. The information that is frequently provided to the pilots out of that system is not something that they can use in the final moments of a takeoff or landing in order to make the decisions that they have to make in order to avoid tragic circumstances, and we think the FAA needs to be—we are not by any means satisfied with what they have done in their use of that system.

Senator **Kassebaum**. The FAA is launching a program to better train pilots through the use of simulators for wind shear activity, which I think is terribly important. No matter how many detection systems we may have and how much the technology's improved, the pilot has to know how to respond.

Do you feel this is a problem? And let me speak specifically to the L-1011 crash in Dallas and a couple of aspects of that accident.

That pilot and copilot, it is my understanding, had had simulator training, is this correct?

Mr. **Burnett**. Well, first let me say that I am going to be holding hearings in Dallas on that the week of the 28th of October, and we still have that very much under investigation. It is my understanding at this point that we cannot document that this pilot had had simulator training involving flying though a wind shear. Now, the problem with that is that the airlines do not and are not required to keep records on exactly what type of simulator training they give their pilots. They have to record the fact that they received simulator training, but the decision as to what to train them in, whether it is going to be wind shear, flying through wind shear or some other problem, executing a go-around when you see an aircraft on the runway, is up to the instructor, and in the Delta situation, they do not have any set pattern to do this. It is up, if you will, to the whim of the instructor, and no record is made. So we cannot tell at this point whether that flight crew ever got this. It could be possibly conjectured that they did because this certainly has been an emphasis area recently, but we cannot really establish it at this point.

Senator **Kassebaum**. It seems to me that would be a very important record to have.

Mr. **Burnett**. Well, it does at the Safety Board, and I think we will certainly be looking at that in terms of safety recommendations.

Senator **Kassebaum**. There has also been concern expressed, and perhaps you do not want to get too far into that until your hearing, about the controller's wisdom in reducing the L-1011's airspeed to 60 knots, given the particular situation at the airport at that time.

Do you see this as a factor?

Mr. **Burnett**. Well, I believe that at the time of the accident, that aircraft would have been reduced back to that speed anyway in execution of the landing. So that if it—it might have been relevant in another, had the wind shear been or the weather condition which we are fairly sure is a wind shear, but beyond that, what type we do not know—had been encountered earlier in the landing, in the approach process, that might have been relevant. We are still looking at that issue, but I do not think that that is going to be—not does not appear to be a major issue at this point.

Senator **Kassebaum**. But the controller, had he known the weather better, would not have ordered that particular reduction, would he?

Mr. **Burnett**. Well, that would be another question that I think we will have to analyze in the course of the investigation.

Senator **Kassebaum**. I understand you have personally been involved in investigations of runway incursions. Specifically, I am thinking of the Minneapolis incident. I would like to ask you if, as a result of the concern over the apparent increase in either near misses or runway incursions, whether you believe these increases are the result of improved reporting, as has been stated, or if they are evidence of some failure in our air traffic control procedures?

Mr. **Burnett**. Well, speaking particularly of runway incursions, those that we are investigating right now, I think clearly we have a trend there that the Safety Board is concerned about.

Now, there has been a lot of discussion in the public media about increases in near misses in the air, and by the way, these near misses on the ground, or near collisions we prefer to call them, are not included in those totals in the air, so——

Senator **Kassebaum**. Then the runway incursions are a separate total?

Mr. **Burnett**. Well, I do not think they even maintain a count of that. The Safety Board is sort of counting them right now, but I do not think the FAA does as far as I know. But they are not included in the near mid-air collision counts that the FAA keeps.

I do not think we can say that we have had an increase in number of near mid-air collisions. We have had an increase in the number that are being counted, but that is quite apt to be affected by several factors that impact upon the frequency of reporting. Because you do not have comprehensive reporting, we have never had that, the number—the fact that there has been an increase in the number counted does not necessarily mean a diminishment of safety. But we are very much concerned about this runway incursion problem, and it continues, and there are some—I believe it is a trend that is very disturbing.

Senator **Kassebaum**. But you do not see it necessarily relating to air traffic control problems in the control tower.

Mr. **Burnett**. Oh, yes; most of them do relate to problems in the control tower and they relate to coordination between two controllers. A large number of them, I do not know whether we can yet say that it is statistically significant, but it is something we are looking at, involve situations where there was no supervisor to back up the local controller and the ground controller in their coordination. So we definitely do have, and I think the FAA has recognized that they are going to have to do something to formalize this process of communication between the local controller and the ground controller, and they are handing off basically control of the runway back and forth.

It has been a very informal, back of the hand type of process, and it is simply not working under the conditions that we have at the Nation's airports today.

Senator KASSEBAUM. Thank you very much, Mr. Burnett.

Senator Ford.

Senator FORD. Thank you, Madam Chairman.

Mr. Burnett, how close is a near miss?

Mr. BURNETT. Well, the FAA, I do not want to try to recall all the criteria they have for their near miss, but some of the things that are counted as near misses are not imminent collisions, Senator.

Senator FORD. Well, try layman's language. Is it 50 feet, 100 feet, 500 feet, 1,000?

Mr. BURNETT. Five hundred feet—500 feet is very, very close for two aircraft.

Senator FORD. OK.

You made a statement earlier in your opening remarks about wind shear accidents in the years to come before, apparently, a statement from the admiral, at least what he said, before we can get the Doppler or some other system in place. Did you say that we would have—that there's been an average of one wind shear accident a year?

Mr. BURNETT. Yes. Counting the one in Dallas, we have documented 18 of them since 1970.

Senator FORD. Eighteen since 1970?

Mr. BURNETT. Now, there was a period between 1977 and 1982, a 5-year period there, that there were none at least that we were able to document, so that means for much of that period there may have been three or more a year.

Fortunately, the majority of these were not fatal accidents, but they were all the type that very easily could have been had it not been for very fortunate circumstances and in some cases very good recovery techniques by pilots.

So—and you have to realize that for all of that period we had much less air traffic than we have at the present time and that we expect in the next few years. So just on the basis of the amount of—the number of planes that are out there potentially encountering microbursts, we could expect to have a greater frequency of those accidents in the coming 4 or 5 years than we have experienced over the last 15.

Senator FORD. In your statement, you say we believe that FAA has to pursue a priority program to purchase Doppler radar for terminal areas while it pursues the R&D programs needed to automate the radar data into an operational, useful product.

Are you saying that the National Transportation Safety Board is encouraging FAA to go on and purchase a Doppler, get it into place?

Mr. **Burnett**. We believe they should go ahead with the purchase of the Doppler and at the same time be designing their software. We believe that there is no reason that what they can now purchase and expect to purchase would not be made—could not be made to match up with the design of the software system that they could be working on concurrently.

Senator **Ford**. Is there anything in your mind that would say that the FAA does not have the money available in the Airport Improvement Fund but they can proceed with that kind of purchase? Every time you get on an airplane, every passenger is paying a piece of that ticket for safety.

Mr. **Burnett**. Well, Senator, the Safety Board, we do not try to audit that fund, and I——

Senator **Ford**. I do not want you to audit it. I just want you to tell me if you think they have got enough money.

Mr. **Burnett**. Well, it is going to be very expensive, but as to where the money comes from, out of what fund it comes is something that the Safety Board has no expertise in.

Senator **Ford**. Well, I would have liked a straightforward answer, but I got a bureaucratic one.

Mr. **Burnett**. I will try just to give you one in this testimony, Senator.

Senator **Ford**. One bureaucratic answer?

Mr. **Burnett**. Yes, sir.

Senator **Ford**. Well, you are over with then, so let's go.

Well, it is my understanding that Boeing will be placing some form of wind shear equipment on their airplanes.

Will this enhance the Doppler Program? Are you familiar with that? I am not too familiar with it, that what Boeing wants to do as it relates to wind shear. Will that fit into the Doppler system?

Mr. **Burnett**. Well, I am not sure what Boeing program you are speaking of. You might ask Mr. Laynor, who is going to appear on the wind shear panel, if he is aware of what——

Senator **Ford**. All right, I will get to him, but I thought maybe with your responsibility for transportation safety, that you might have had some information as it relates to that, some judgment as it might relate to that.

Mr. **Burnett**. I am not personally aware of a program that Boeing has to add to the aircraft right now as far as wind shear is concerned.

Senator **Ford**. I noticed on the news this week that you all are requesting that flight recorders be placed on all commuter airlines.

Mr. **Burnett**. We have been doing that for some time

Senator **Ford**. All right.

What would be the cost of those recorders?

Mr. **Burnett**. They are expensive, but we believe that in relation to the cost of modern, up to date aircraft, that they are relatively inexpensive. We believe that a combination flight data recorder and cockpit voice recorder can be developed, and it is actually in the process of development, which will be much less expensive than those recorders that are available today.

Senator **Ford**. You say will be expensive. Well, what is expensive?

Mr. BURNETT. Well, since what we have in mind really has not been developed, you cannot get it on the shelf, I am not able to tell you that.

Senator FORD. Well, you are talking about more research and development, and down the pike installation.

Mr. BURNETT. Well, I do not think it is a matter of research and development. I think once the market develops, and in order for the market to develop you have to have a regulation, certainly the instrument will be made available, and it will not require further development. It is not on the shelf right now. I would say that.

Senator FORD. Is there any reason why we cannot create a market to save lives?

Mr. BURNETT. I do not think so. I think it would be—the Safety Board has been encouraging that for some time.

Senator FORD. I would not be adverse to a regulation that would install the recorders if it would have some ability to save lives.

Mr. BURNETT. We appreciate your support of that, Senator.

Senator FORD. Are accidents involving commuter airlines increasing?

Mr. BURNETT. Over that—the Administrator is correct that there has been a dramatic reduction in commuter airline accidents. Now, they did not have nearly as good a year in terms of the number of fatalities in 1984 as they had in 1983. The rate was only—it may have actually been less, the fatal accident rate. They have really had a dramatic turnaround in that industry over the last 5 years. I think they are due a lot of credit for that.

They do not have an accident rate nearly as favorable as for major carrier aviation, nor will they ever have because by the nature of commuter flights, they are flying into smaller airports, many of them may be uncontrolled airports. They are flying through weather instead of above weather. They just, the nature of that type of air transportation is not as safe as it is for major carriers, but it certainly can be made a lot safer than it is now, and the Safety Board has made many recommendations, some of which the FAA has adopted, in order to try and improve commuter airline safety.

Senator FORD. Are there any differences between the safety standards of small airlines, including commuters, in comparison with the standards for larger airlines?

Mr. BURNETT. Yes, Senator; there are. They are regulated under a different part of the Federal Aviation Regulations, part 135 rather than part 21, and there are significant differences between those. Some I think are probably justified; others are not.

Senator FORD. You are investigating the Dallas accident. Maybe you will want to hold off on this.

In viewing the site, the airplane hit water towers that were placed on the airport property. Am I correct in that?

Mr. BURNETT. Yes, it did strike a water tower.

Senator FORD. All right. If that water tower had not been there, the guestimate is that probably the crash would not have been as bad because——

Mr. BURNETT. I do not know that we would concur with that. The problem is, Senator, that they were——

Senator **Ford**. Well, you can read anything in the newspaper, so let's just talk about anything here.

That airplane, if the tower had not been there and the plane would have skidded rather than have struck the tower, there is that possibility that it would not have been quite as bad as it was. Does that possibility not exist?

Mr. **Burnett**. We are going to try to compute that in the course of the accident investigation. It may not have been reported by some of the newspapers that reported that, but beyond those water towers there were several airplanes loaded with fuel, and had this plane struck those airplanes, we might have had a worse condition also. So right now, whether that would have happened or not, I cannot tell you.

Senator **Ford**. I understand. The point I am getting to though, sir; is this that is your responsibility not what is on the airport property itself and what safety factors it might create or improve?

Mr. **Burnett**. We will certainly look at that in the course of the investigation. We are looking at it.

Senator **Ford**. I have a letter from a young man who lost his wife in that particular accident in Dallas, and in conclusion he says "I would like for my wife Jayne and others not to have lost their lives in vain. We must build this new radar system in order to eliminate the danger of wind shear accidents. Please help in pushing this system and making our air travel even safer, so that no one else would suffer."

And Madam Chairman, he sets out the Doppler system, and apparently as a result of that accident has looked at every face of that system. I would like to place this letter to me from, I believe his name is Brian Salmonetti, in the record.

Senator **Kassebaum**. Without objection.

[The letter referred to follows:]

Houston, TX, *September 10, 1985.*

Hon. Wendell H. Ford,
U.S. Senate,
Washington, DC.

Dear Senator Ford: My name is Brian Sulmonetti, and I am a victim of the Delta Flight 191 tradegy. My wife, Jayne Valecce Sulmonetti, died in that plane crash.

Her death and the 133 others should not be in vain. Something positive has to come of this accident. Congress and the Administration have an opportunity to improve air travel by supporting the research, development, and implementation of airport based Doppler radar systems.

As you may know, preliminary reports blame wind shear or microbursts as one of the causes of the crash. This is where Congress and you can have an impact. The FAA has been working on a radar system that could detect microbursts and therefore save countless lives. The system is expensive, but in view of the recent lives lost because of wind shear, I think the costs of this new radar system are insignificant.

Unfortunately, it sometimes takes a terrible tragedy to get something done, so let's use this crash as an impetus and push for the deployment of the Doppler radar systems. Hopefully, this will make wind shear a hazard pilots can safely avoid.

The action steps Congress must take are:

1. Support Chairman Norman Y. Mineta's (D-CA) efforts to hold hearings on October 2nd in the House Public Works and Transportation Subcommittee on Aviation. Also, make sure the proper people and experts are heard.
2. Make sure the new Doppler radar system is brought on-line in a timely fashion, and explore methods of building an even better system.
3. Pressure the Administration, particularly OMB, not to postpone or slow down funding for this system; and in fact, tell them to accelerate funding and make it a

priority in the FAA budget. Also, explore ways to increase funding for air safety measures by either increasing the 8 percent surcharge on passenger tickets to 10 percent and having the increase earmarked for new radar system (I don't think any passenger would argue!), or by creating a joint public/private effort to bring these new radar systems on line. I think the government, the airlines, the airports, the pilot's union, and airplane manufacturers could work out a very nice joint effort that would not cost the taxpayers.

4. Support any efforts for legislation in this critical area and any efforts to hold Senate hearings on this subject.

In conclusion, I would like for my wife Jayne and others not to have lost their lives in vain. We must build this new radar system in order to eliminate the danger of wind shear accidents. Please help in pushing this system and making air travel even safer. No one else should needlessly suffer the type of tragedy that I and the families of the other victims of Delta Flight 191 are experiencing.

Sincerely yours,

BRIAN SULMONETTI.

Senator **FORD**. I thank you.

That is all.

Senator **KASSEBAUM**. Chairman Danforth, it is a pleasure to welcome you.

The **CHAIRMAN**. Thank you.

Mr. Burnett, it is often said that flying is the safest way to travel. In light of the well publicized and very tragic accidents that have occurred recently, is it still the safest way to travel?

Mr. **BURNETT**. As far as major carrier aviation is concerned, it undoubtedly is the safest way to travel, Senator.

The **CHAIRMAN**. Meaning that flying on a major carrier such as TWA or American is safer than going by car, train, or bus, the alternatives?

Mr. **BURNETT**. Well, I do not think we need to disguise the fact that rail, passenger rail in the United States and intercity bus, the passenger bus lines, the major national bus lines, have also an outstanding record, one that is enviable.

The **CHAIRMAN**. But flying is still the safest way to travel?

Mr. **BURNETT**. It is the safest.

The **CHAIRMAN**. So we should be concerned about the accidents but we should put them in perspective and not push the panic button.

Mr. **BURNETT**. No; I do not think there is any basis for the aviation consumer to be alarmed that we have had a derrogation in safety. We have seen over the past several years in which we have had an outstanding safety record, that these for some reason come in peaks and valleys, that we have—for instance, we had 1980 and we had 1984 without any air crashes, fatal air crashes, and then we have years like 1981 and 1985 in which things are relatively worse.

Why that is, I am not sure, but we do not see any trends here that are being reflected by the accidents. We see some in the incidents, and there are some things over which I am concerned, but I certainly would not advise the aviation consumer to go out and take some alternate form of transportation.

The **CHAIRMAN**. Now, when I asked you the question whether flying is the safest way to travel, your response was somewhat qualified. You said something to the effect that the major airlines are the safest way to travel.

Does that qualification mean you do not think commuter airlines or general aviation are as safe as the major carriers?

Mr. **Burnett**. Well, there is a marked difference in the safety, the accident rate when you look at the different categories, and we cannot obscure that. It should also be remembered that when you look at the accident rate for highway, for instance, for driving your own personal car, that that accident rate is impacted seriously by people who do very stupid things which I or any individual consumer could control. So if we set out in our own car, assuming we are not going to drink, we are not going to drive late at night and doing some of those things, we can improve the chances that we get to a destination safely very much. Beyond or above what the overall accident rate would suggest.

So I am a little bit reluctant to buy off on that, you know, we are many, many times safer in all forms of aviation, which some people have suggested at times, without qualifying that.

The **Chairman**. Is the problem, if there is one, with commuter airlines and general aviation, that there are a lot of people flying planes and that some of them are not as safety conscious as they should be?

Mr. **Burnett**. Well, we have had a great increase in the number of operators, air carrier commercial operators in the last few years since deregulation, both in the major carrier segment of the industry and in the part 121 regulated and the part 135 area. Certainly there has not been in my view an appropriate response from the Federal Aviation Administration to surveilling that changed aviation environment.

In addition, we have right now, for instance, a whole lot of pressure on the commuter carriers, they are having a hard time maintaining their pilots because the majors are hiring, and people who fly would rather fly for the majors. So it makes it very difficult for them to keep—so that they cannot invest the kind of money in training that it would be desirable for them to invest unless you have a stable work force.

So there are all kinds of problems out there, but I do not think that should obscure the fact that they have made a tremendous effort and effective improvement over the past few years.

The **Chairman**. Do you recommend that the FAA undertake a study to determine whether the best people flying for the commuter airlines are being siphoned off into the large commercial airlines?

Mr. **Burnett**. Well, I think, I have been saying for some time that I think the FAA needs—it has not been a matter of just the numbers of inspectors they have but the strategy with which they use them and the techniques that they adopt, and I think that traditionally with the traditional major carriers you had a principal maintenance inspector who related to the vice president for maintenance, a principal operations inspector who related to the vice president for operations. You had a very formalized, sort of choreographed almost kind of relationship between them. You really did not have FAA inspectors getting out on the line if they were maintenance a whole lot, or—they would, of course, do the inspection of the crew, the flight checks and that sort of thing, check rides and had various oversight of operations in that way, but basically it was sort of a very, if the Chairman will excuse this, a very gentlemanly type of arrangement that I do not think with the kind of turnover we have in the numbers of carriers and the personnel that is involved, is really appropriate to the regulatory and surveillance challenges that are present today, and I do not think——

The CHAIRMAN. What would you recommend?

Mr. BURNETT. Well, I think it is going to have to be up to the FAA to design a new program. I think they are going to have to do more to train their inspectors who maybe have great technical qualifications, and train them in inspection and detection techniques, what you need to cross check in order to discover that something may not be quite kosher. I do not think they are doing enough of that.

In addition, we have a lot of the commuter airlines that are being surveilled by people who basically come out of a general aviation background, and of course, the regulations for general aviation are not as demanding as they are for, for instance, for air carrier. In fact, in the Air Illinois investigation we found essentially a general aviation district office was administering a part 121 regulatory program. Well, what they ordinarily do day in and day out is not nearly as demanding as those part 121 regulations. So there are some problems there that they need to meet, and I think generally decide that they are going to be more aggressive and less passive in trying to discover violations of the rules.

The CHAIRMAN. We are not going to turn the clock back on deregulation. However, the ordinary passenger going to the airport realizes that, particularly during peak times of the day, that there is just an enormous amount of traffic, a lot of passengers milling through airports, and a lot of planes taking off and landing. With the advent not only of more flexibility in scheduling and pricing, but of more commuter airlines flying around, do you think that the system might be overloaded right now?

Mr. BURNETT. Well, I have some concerns in that area. For instance, when we looked at the runway incursion problem, undoubtedly that is related to the congestion we have at airports and in fact we are not building new airports. We have the hub-type system which means that particular airports are a lot more congested than others, and the ability of the ground controller to manage that at peak times has been—will probably prove out to be a factor in what we have seen.

We have also, of course, the only way that our air traffic control system has been able to operate safely, and I think it has, and probably perhaps even with some improvements on what existed before the strike, was the fact that we have had very close control of traffic, and when the FAA has backed off on flow control, they have run a great risk, and I think that is a desirable thing and needs to be continued.

But obviously it restricts what economically the airlines would like to provide as service to their passengers. So we are up against some restricting factors there.

But the bottom line on it right now is that I certainly do not think we have a crisis. I think we have some things we need to watch and some things we need to be doing in anticipation of an aviation that is going to continue to grow.

The CHAIRMAN. I wanted to set out in my initial question the fact that flying is still the safest way to travel. But that does not remove our obligation to try and make sure that it is even safer than it is now.

Tell me the GAO has indicated that the morale and efficiency of air traffic controllers might be declining a little bit. Do you agree with that? Do you think that there is a problem of morale and a problem of efficiency, of overload, of air traffic controllers?

Mr. **Burnett**. Senator, we did two investigations following the strike of air traffic controllers, one immediately following the strike to see if it was operating safely in that interim and then one after the system began to be rebuilt.

At that time we found the beginnings of what we would describe as some problems. The kind of enthusiasm that all of the controllers who stayed with the system had for it immediately after the strike was beginning to wear a bit thin afterward. Many of them had been working long hours.

Now, we think the FAA has made progress since we last looked at it in dealing with that. But certainly they had people working overtime to the point I think it would have been a performance problem for them.

The problem of not having backup supervision, especially for your less experienced people, when they might run the risk of getting into sort of a hairy management situation as far as managing traffic, not having somebody they could turn to or somebody that is looking over their shoulder, that might observe that they are getting a little bit beyond what they can handle, certainly must be a matter of concern to those people.

Again, I do not think that we have a crisis in air traffic control as long as we maintain very strictly the flow control to keep peak loads from getting beyond the ability of the system to handle it. But if we do not do that, we have a bad problem.

The **Chairman**. Could I just ask one more question, Madam Chairman?

Do you have any overall recommendation to make to us, to the FAA, or to anyone else with respect to the possible problem of system overload as a result of deregulation and the corresponding increase in traffic?

Mr. **Burnett**. Well, first, as far as it impacts on the air traffic control system, we are determined we are not going to let it overload. We are going to maintain the traffic at levels that can be managed and then move to increase the capacity of the system, both in terms of available airports at places where the air carriers want them and in terms of controlling manpower.

We must not allow the system to become overloaded nor even to get back to what it was in 1981 with the sort of complicated stacking patterns that we had over the major cities, in my opinion. And I think we can handle that. That is something that is doable.

It is not doable without some unpleasant side effects, and we have to be prepared to face up to those.

Senator **Ford**. I do not want to make you mad. This will be my last question of the day. How is that?

Senator **Kassebaum**. Senator Ford.

Senator **Ford**. For one who traveled 400,000 commercial air miles in 1956, almost 30 years ago, I have got a feeling my odds are getting closer together all the time, and I want to improve on those odds as best I can.

What about any research and development or improvement after the flight crew were able to land Air Canada at Cincinnati Airport. Any improvements in seat and material flammability and that sort of thing? Has anything been done that would give me comfort that, if the pilots go through all of this and the airplane is on the ground safely and the personnel, the flight attendants do what they are supposed to do, yet my chances of survival are not too good?

Mr. **Burnett**. Regulatorily, Senator, the last year, year and a half, we have experienced a great leap forward in aircraft cabin safety as it relates to fire, the fire hazard. Many of those safety reforms that have been mandated by safety regulations are not actually in the aircraft now, so those of us who are traveling do not yet have the benefit of them. But we will have.

Senator **Ford**. How soon?

Mr. **Burnett**. Well, some of them are a several year introduction process. But I think the FAA basically has been fairly reasonable in that. In other words, when they replace interiors they are required to substitute these new materials, and they have got them on a fairly tight implementation schedule in relation to that, I think beyond what I expected the FAA to do, frankly.

Senator **Ford**. Thank you, Mr. Chairman.

Senator **Kassebaum**. Thank you very much, Mr. Burnett. We appreciate it.

Our next witness is Mr. Herbert McLure, Associate Director, General Accounting Office.

Welcome, Mr. McLure. We always welcome GAO's attempts to keep us informed.

STATEMENT OF HERBERT R. McLURE, ASSOCIATE DIRECTOR, GENERAL ACCOUNTING OFFICE, ACCOMPANIED BY CHARLES S. COTTON, GROUP DIRECTOR

Mr. **McLure**. Thank you.

I tried reading our statement the other night. It took about 35 minutes, so I will ask that you enter it into the record and I will try to summarize it.

The **Chairman**. Mr. McLure, could you lift your microphone a little bit so you are speaking right into it.

That is better. Thank you very much.

Senator **Kassebaum**. Your full statement will be made a part of the record.

Mr. **McLure**. Thank you. Charlie Cotton is here at the table with me, mainly to make sure when I summarize, I stick with the facts. The signal to look for is when he buries his face in his hands, I have probably done it wrong.

We have recently worked on all three of the topics that are being discussed here today. To answer some questions we received about the status and adequacy of the air traffic control system, we sent questionnaires to about 4,500 full performance level controllers and developmental controllers, 1,000 of their first-line supervisors, and the managers at the 20 en route centers and 54 busiest terminal facilities. The questionnaires asked for their opinions and experi-

BEST COPY AVAILABLE

ence on a number of topics, including controller staffing levels, air traffic activity, controller workload, and training for new controllers. In addition, we are also examining FAA data concernng these topics.

Most of the controllers, supervisors, and managers who answered our questionnaire rate the overall safety of the air traffic control system as adequate to excellent; 83 percent of the controllers, 93 percent of their supervisors, and all the facility managers shared this opinion. But they also expressed concern about several conditions they think ought to be addressed.

One concern was that air traffic has returned to prestrike levels, but is being controlled by 5,000 fewer FPL controllers than before the strike; 70 percent of the controllers believe they are required to handle more traffic during daily peak periods than they should be handling. Their supervisors believe only 38 percent are handling too much traffic, but even that number represents more than 2,000 controllers.

FAA's effort to rebuild the controller population after the 1981 strike has gone slower than expected. For example, in June 1982 FAA said its goal was to have about 6,600 full performance level controllers by July 1984. But as of June of this year, they were still 300 short of the 1984 goal. The rebuilding process is complicated by the fact that FAA may soon lose many of its experienced controllers to retirement. About 15 percent of the controllers—that is 570—told us they will be eligible to retire within 2 years and 84 percent of those said they probably will retire.

Attrition of the first-line supervisors could be even greater. Of 880 supervisors responding, half said they will reach retirement eligibility in 2 years and 81 percent of those said they will probably retire. In addition to supervising, the supervisors told us they spend about 36 percent of their time actually controlling traffic.

Overall, 86 percent of the supervisors, 91 percent of the controllers, and 72 percent of the facility managers said that there are now fewer full performance line controllers than are needed.

Another concern was the quality of training being provided for developmental controllers. More than half the supervisors told us the developmental controllers skill levels were having a negative effect on maintaining system safety; 45 percent of the controllers shared that opinion. Large percentages of the controllers and their supervisors rated some important safety-related aspects of their training as less than adequate to poor.

DOT's recent decision to increase the controller work force by 1,000 seems a step in the right direction, at least according to the results of this survey. But staffing increases are only a partial, long-term remedy to current problems, and our survey has identified some other safety-related concerns controllers say need immediate attention. We will discuss these concerns in detail in our report on the survey results after we complete our full analysis. Remember, we only got these questionnaires back late July, and we have not really analyzed all the information in them.

In connection with the second topic, the inspections, in August of this year we compiled and analyzed data on the type, frequency, and results of fiscal year 1984 inspections covering air carrier personnel, aircraft, and facilities for a sample of 92 of our approximately 500 scheduled commercial air carriers.

We reviewed about 12,000 individual inspection reports. We found that, when grouped according to operating hours, there are some air carriers with a similar number of operating hours that had significant differences in the number of FAA inspections they received, and some carriers who received similar numbers of inspections had large differences in total operating hours.

For example, an airline with about 41,000 operating hours had 571 FAA inspections, whereas another airline with about 1,000 more operating hours had only one-third the number of inspections. Conversely, an airline with about 90,000 hours received 274 inspections, whereas another airline with about 56 percent more hours than that received just the same number of inspections.

We also found some airlines that did not receive any operations or avionics inspections at all, and found considerable variation in the proportions of the various kinds of inspections performed from region to region and carrier to carrier.

FAA indicates there are valid reasons for some of the variances we found and that comparing inspections per operating hours is not the only appropriate measure. Nevertheless, FAA said it has begun to improve the inspection program by correcting staffing deficiencies and implementing guidelines which specify minimum numbers of inspections.

We have recently begun a review following up our data to figure out why the variations did exist, whether there is a problem, and whether FAA's actions will lead to improvements. Meantime, in addition to hiring more controllers, as you heard, DOT also announced a planned increase in the number of air carrier inspectors.

In summarizing our observations on FAA's efforts to develop a terminal Doppler weather radar system to detect and warn of low-level wind shear, I would like to mention the controllers' response to one of our survey questions about providing pilots with weather advisories. About 1 out of every 5 of the controllers said they often decline to provide pilots with weather advisories while working daily peak traffic periods.

On July 19, we met with FAA's Administrator to share our observations and suggestions relating to terminal Doppler radar. FAA is under considerable pressure, as you have heard this morning, to improve air traffic control safety, and is trying to automate and improve as many of its control functions as possible.

Wind shear is an important problem and FAA would like to provide Doppler radar, which can see wind shear, at airports to warn pilots. FAA is also involved, with DOT and the National Weather Service, in developing an improved weather system across the entire country called Nexrad.

Nexrad will use Doppler radar to spot tornadoes, gust fronts and other dramatic wind occurrences. FAA wants to install the airport Dopplers as soon as possible, and one of its contractors has estimated they can trim up to 3 years off the time it will take to develop and buy the airport Doppler system if they combine its purchase with Nexrad. The way they save the time will be by shortcutting some procurement steps that would be required if they purchased the airport Doppler separately. They are able to shortcut the steps because they have already gone through them for Nexrad and so they will not have to repeat them for the airport Doppler if the two buys were combined.

In a nutshell, we think Nexrad and the airport Doppler are two different things and that skipping the procurement steps for the airport Doppler would involve some important risks; mainly, that we will pay too much for the system or that it will not work as well as it should, or both. Now, here is the way we reason that through.

Nexrad and the airport Doppler differ in both their purpose and technical requirements. Nexrad Doppler is long-range, 145 to 290 miles, and is to identify very large wind shear formations. The National Weather Service meteorologists will operate Nexrad.

The airport Doppler, on the other hand, is to detect small, low wind shears, including violent, rapidly developing, vertical wind shears called microbursts, right in the glide paths around airports. Airport Dopplers are to be automated, with computers interpreting what the radar shows and immediately alerting controllers. No meteorologists will be present.

The Nexrad and airport Dopplers have three critically different technical requirements. First, the airport Doppler will have to contend with a lot of ground clutter around airports, where Nexrad will be out in the country and will not.

Second, the airport Doppler must be able to provide new information very rapidly, ideally in less than 1 minute. Nexrad only needs to update its information every 5 minutes or so.

Third, the airport Doppler must be fully automated, where Nexrad will be interpreted by a meteorologist.

It seems clear to us that Nexrad's development, which is nearly complete, would not have solved the technical problems presented by the airport Doppler, and that considerable development of the airport system still lies ahead, particularly linking the computer to the radar so it can work automatically.

In July, we suggested three things to FAA:

One, that they use existing wind shear detection devices to collect data to help them decide where the airport Dopplers are most needed;

Two, that they test a production unit at an airport before they buy the system;

And three, that they re-examine the cost of the airport Doppler to see if they can get more radars for the same money.

FAA agreed to the first suggestion, but not to the second or third. On the testing point, one of FAA's own contractors recently told them that failure to adequately test operational systems in the field prior to full procurement is a major cause of subsequent performance problems.

On the cost point, the present estimated life cycle cost for each airport Doppler is $4 million. FAA's systems integration engineering contractor, Martin Marietta, found that only about 15 airports would have a positive cost-benefit ratio using that cost. By adjusting some benefits numbers, they eventually increased the number of airports to between 41 and 101.

We would like to see FAA try adjusting some of the cost numbers, too. One way to do so would be to follow the normal procurement steps for a half billion dollar procurement, which include competitive exploration of alternative systems and a competitive demonstration.

We know FAA is under a lot of pressure to move quickly, and we think there may be some things they could do that would improve wind shear safety in the near term while they are developing the airport Doppler properly. NTSB has over the last 10 years recommended 34 ways to reduce wind shear risks. FAA has acted on some, but among those still open are:

The need to use weather information as criteria for delaying arrivals and departures in severe weather conditions;

And the need to develop training aids, such as educational video tapes for pilots and controllers, and to encourage air carriers to provide their pilots with simulator training that incorporates microburst models for avoiding and escaping wind shears.

It seems that FAA could take action along these lines fairly quickly, and that they would continue to be useful even after the airport Doppler is developed. For example, Martin Marietta calculated that about 29 percent of all aviation wind shear accidents would still occur even with a fully automated airport Doppler.

That concludes my testimony and I will be happy to answer questions.

Senator KASSEBAUM. Thank you very much, Mr. McLure.

I would like to just follow up on that a moment. You said that you recommended testing at airports. Has terminal Doppler been tested or used at Denver's Stapleton and in Memphis?

Mr. MCLURE. They are using some of the hardware. The testing that is going on involves meteorologists using the radar and then relaying information from that. The key to the system, as NTSB just said, is connecting the computers so that it can be automatic. We think they need to test that.

Senator KASSEBAUM. And that has not been tested anywhere?

Mr. MCLURE. Not so far. Right.

Senator KASSEBAUM. I sense that you are skeptical about racing ahead pellmell with this?

Mr. MCLURE. Yes, I think we have some skepticism. We understand FAA is under pressure. We do think they ought to move as quickly as they can without taking unnecessary risks, and we are talking about a half a billion dollar purchase.

Senator KASSEBAUM. I was interested in your comment dealing with the wind shear phenomenon. I believe that pilot training in simulators and test training is enormously important.

But I am also interested in your statement that controllers decline to give weather advisories during peak hours. Is this because they just have so much to contend with at that point that they do not have time to relay weather advisories?

Mr. MCLURE. At this point we have only had time to actually compile the numbers in the survey instrument. Most of the controllers who responded to our questionnaires gave us narrative comments as well. We have not had time to analyze those. Chances are that some of those narrative comments will address the question you just asked.

As of now, all I can tell you is that 1 of 5 said that sometimes they do not give those advisories.

Mr. **Cotton**. Madam Chairman, that question, too, was presented in such a way that we asked them: When you are the busiest, what do you not do? And that was one of their actions that they normally take, that they can take, that they did not do when they were at the high-peak period.

Senator **Kassebaum**. Are you saying that you feel one thing that should be considered is delaying departures and arrivals in bad weather? I realize that this is something that is done now, but this is largely at a pilot's discretion.

Mr. **McLure**. Yes; that is one of the things that NTSB has recommended, that there be some kind of threshold or guidance given by FAA as to what decision a pilot should make. I understand there is a great deal of problems with implementing that kind of a program, implementing that kind of a recommendation. Nevertheless, it does seem intriguing to people who fly.

Mr. **Cotton**. One of the biggest problems right now is getting current information to the controller and then ultimately to the pilot to make an informed decision.

Senator **Kassebaum**. Where do you think the problem lies, in getting the information to the controller, or in the limits of a controller's capacity during peak hours, and an inability to relay that information?

Mr. **Cotton**. If they had the automation available to get the information to the controller and he was informed of severe weather conditions, one would have to assume that, regardless of how busy he was, he would get the information to the pilot. Right now they do not have the automation. They do not have the software to get current data up to the controller and ultimately up to the pilot.

Senator **Kassebaum**. Have you done any work in your study on the status of automation of the control tower?

Mr. **Cotton**. The automation of the control tower is part of the national air space system plan to consolidate, automate, and modernize the whole system. As we identify in our testimony here, the automation that was promised the controller will not be available for another 5 to 7 years. So right now they are basically functioning with the same equipment that they did before the strike, with 5,000 fewer full performance controllers and approximately the same level of activity.

Senator **Kassebaum**. I know there have been some estimates that it is about 2 years behind, but you are saying 5 to 7?

Mr. **Cotton**. It all depends on what part of the system you are looking at. The automation that was promised the controller is approximately—well, they are saying by the early 1990's.

Senator **Kassebaum**. Who is saying that?

Mr. **Cotton**. FAA.

Senator **Kassebaum**. You mentioned the lack of uniformity of the inspections. The FAA has now announced some plans for improvement. Do you believe this is going to be successful as far as your analysis of the initial problem that existed?

Mr. **McLure**. Successful in the sense that inspectors will get better coverage, I think so. I think it is a step in the right direction. They are contemplating minimum standards for how often to inspect air carriers. We think that is a good idea.

Senator **Kassebaum**. There has been great disparity among the regions as to inspection type and frequency. It is frequently mentioned that over time, inspectors become very comfortable with those when they are inspecting. How often are inspectors rotated? Did you analyze that as part of the problem?

Mr. **McLure**. That is not something we looked at specifically in the data that we presented in August. That is one of the things that we will address in the work we are currently working on that we will finish next spring.

Senator **Kassebaum**. There have been complaints for many, many years about morale in air traffic control facilities. That does not seem to have changed.

Do you think the addition of controllers will help fill the gap between today's need and the time when automation will be in place?

Mr. **McLure**. The questionnaire—the responses to our questionnaire clearly indicate that the controllers and their supervisors feel that they are, at least at times, overworked. So it seems to me that adding controllers is the logical thing to do.

It is not all that easy to add controllers, though. They do have a training period they go through and they have a fair attrition in that process. To get 1,000 more controllers, they really have to talk about hiring and training some multiple of that number.

Senator **Kassebaum**. I think about 350 supervisors indicated they planned to retire within the next 2 years. Is there going to be a real diminution of experience at that point? Have you made any recommendations? What would you recommend be done to address the resulting lack of experience?

Mr. **McLure**. Well, we have not made any recommendations yet, since we have not issued any kind of report. Personally, just glancing at the results that we have compiled in the questionnaire, one of the things that jumped out to me was that many of the controllers who said that they were going to retire said they may be willing to continue working under certain kinds of conditions. And some of the concerns they expressed were concerns about retirement programs and if they had some assurances in that regard. And also, many said they were willing to work part time after they retire.

So there may be some ways that FAA, some things that FAA could do to ameliorate the retirement problem.

Senator **Kassebaum**. Thank you, Mr. McLure.

Senator **Ford**. I think the chairman ventured into the variances in FAA's inspections, and apparently they are beginning to improve that situation. Can you foresee a situation where there would not even be a maintenance schedule available on some aircraft or some airline?

Mr. **McLure**. Based on our experience in looking at the data that we have looked at, yes.

Senator **Ford**. So you are telling this committee, then, Mr. McLure, that airlines could never inspect an airplane, or it would be a verbal statement and you are saying that they would not have a documented inspection on file, where you could go and pull out a file and say, that airplane, old Ford, you are getting on this afternoon, we do not know whether it has ever been inspected or not?

Mr. **McLure**. Yes.

Senator FORD. That is a pretty good answer, I would say.

Mr. COTTON. Senator Ford, in our statement, you will see that 32 percent of all the carriers that we looked at had received no avionics inspections during 1984, and that is looking at the aircraft electronic equipment.

Senator FORD. Are you telling me the air carrier itself had never looked at it?

Mr. COTTON. No. The responsibility lies with the carrier to maintain the equipment. The responsibility of the FAA is to review. And what we are saying is the FAA did not look.

Senator FORD. That does not mean the carrier has not done his job?

Mr. COTTON. No, it does not.

Senator FORD. I want to be very careful in this that we do not raise the impression that the air carrier is not doing his job just because the FAA does not come in and pull out the avionics.

Mr. COTTON. The only question is, does the FAA know what the carrier is doing.

Senator FORD. From your investigation, from what you are saying, the answer is no.

Mr. COTTON. In some cases.

Senator FORD. What about the white glove inspection that the Secretary of Transportation proposed here some time ago? Did you all find any results of that or see any difference, changes?

Mr. COTTON. That was the NATI inspection and that was included in the timeframe that we looked at the FAA inspection program. And it did raise certain questions of why certain deficiencies were identified in NATI that had not been identified in ongoing routine FAA inspections. It also raised some questions as to why carriers that were included in the NATI study subsequently were found to be deficient in a certain way and how NATI missed them, and we are exploring that whole issue in this follow-on review.

Senator FORD. So we will be able to have your interpretation of that when you finish your review?

Mr. COTTON. Yes, sir, this spring.

Senator FORD. On wind shear accidents, did you find out where they occur? Were they all within that 12-mile range? Is that where all the wind shear problems are developed?

Mr. MCLURE. We did not investigate that specifically.

Senator FORD. You went into the Dallas accident, though, did you not?

Mr. MCLURE. We have seen some things in connection with the Dallas accident and others. But the work we did was not designed to look at accidents.

Mr. COTTON. But the type of phenomenon that we are discussing, the microburst, the low level wind shears, that is only applicable really within the terminal area, as the plane is on its glide path.

Senator FORD. So that is the Doppler part, which is the 12-mile radius?

Mr. COTTON. Both Nexrad and the terminal Doppler are Doppler radios. Again, they just differ in purpose and therefore differ in certain technical requirements.

Senator FORD. Well, but Nexrad and the Doppler system are two separate systems. One is on the terminal area, the other is for en route centers. And meteorologists with the Nexrad and their updates should be only about every 5 minutes or something like that?

Mr. McLure. Right.

Senator Ford. Where the Doppler system is in and around the airport itself it should be updated, according to your report, every minute; and FAA gave the impression it ought to be every 45 seconds.

Senator Ford. How close is the Doppler system ready to be installed? There is an impression left from some with me, and maybe I have not grasped it as I should have, but the Doppler system was basically ready to install. You are giving me the impression from reading your report that it is not and that it may be several years away in order to give that 45-second warning to those pilots in an airplane carrying your family.

Mr. McLure. We think that is right. They have not yet created the software needed to automate the radar itself. Now, the radar itself——

Senator Ford. Is ready?

Mr. McLure. Yes.

Senator Ford. If they started installing the Doppler system at the terminal, in your judgment, by the time they get it installed, would the software be ready?

Mr. Cotton. That would just be speculation.

Senator Ford. Well, speculate a little bit. People make livings on speculation.

Mr. Cotton. I would rather have FAA speculate on that than GAO.

Senator Ford. Well, we should lean on you for no speculation.

Mr. McLure. Well, unlike Charlie, I will speculate a little bit but only with what FAA has already made public, and that is that their contractors have told them that they think there is at least a 50/50 chance that they could have software put in and working well by the time all the rest of the system is ready, and the real question here is, is FAA, is it sufficiently important to get that out that you are willing to take the risk that it will not work and that they increase their costs and drag the time out by not going about it in a more normal process.

Senator Ford. With the testing at Denver and the testing in Memphis, how much additional testing is really necessary?

Mr. McLure. Well, the difference in the testing is the testing they are doing now involves a meteorologist. What they are not testing is a system that works with a computer and automatically gives them warning.

Senator Ford. So, we are talking about the 5 minutes out, rather than the 45 seconds inside.

Mr. McLure. I do not think it is really 5 minutes. With a weatherman, meteorologist, watching the scope, they could do a pretty quick warning. But the system itself is designed to be automatic. They do not want to have people with all these radar scopes.

Senator Ford. Well, we blame everything on computers, now. Somebody calls me if they did not get a letter, I say the computer did not spit it out. But would we be better off under the circumstances to install the Doppler system with its ability to transmit to the tower and to the pilot while we are getting the software ready? Would that not improve the situation without costing more money?

Mr. McLure. No.

Senator Ford. It would not?

Mr. McLure. Well, we are not really technically qualified to answer that question.

Senator Ford. Well, you are technically qualified enough to start talking about the integration of the two systems and the differences in the research and the development.

Mr. Cotton. Senator Ford, FAA does not have the trained meteorologists nor are they employable in the immediate future to actually sit in front of that radar, interpret that data and inform the controller, OK? And without that meteorologist sitting there now, without that automation, that system cannot perform its primary function.

Senator Ford. We are talking about a system that could be partially ready if you had the people to operate it.

Mr. Cotton. Correct.

Senator Ford. Since we are talking about cost, how much would it cost to accelerate research? How much would it cost if we tried to cut it down from 5 years to 2½? Is there ability in the research community, because you just said there was a 50/50 chance to have it ready awhile ago, and if you give a manufacturer or an entrepreneur out there the incentive to make some money, boy, you may have it in 2 years instead of 5.

Mr. McLure. One of the procurement steps that we are talking about is the step that provides for competition.

Senator Ford. So?

Mr. McLure. So, in order to speed this up, what they are doing, well, not what they are doing, what they're talking about doing or at least considering doing is eliminating the steps that would provide for the competition you are talking about and give it to one contractor.

Senator Ford. And there are only two companies right now involved in that?

Mr. Cotton. There are two companies involved. Sperry and Raytheon are involved in developing the Nexrad radar.

Senator Ford. Is that also the Doppler system at the airport?

Mr. Cotton. It is also Doppler radar. It is not the terminal Doppler. It is the part of the National Weather Service System.

Senator Ford. Who is doing the research on that terminal?

Mr. Cotton. Lincoln Lab and NCAR are currently under research contract with FAA, and if I could return to your question, FAA is attempting to expedite its research efforts and hopes to put it all together, hopes to put the hardware, the algorithm and the software together at Denver, at Stapleton I believe, in 1987. And based upon that they will decide whether to go forward or not. They have expedited it.

Senator Ford. Based on Mr. Burnett's statement, we will have at least two accidents before that gets together, on average.

Mr. Cotton. According to Mr. Burnett, yes.

Senator Ford. Thank you, Madam Chairman.

Senator Kassebaum. Senator Exon.

Senator Exon. Madam Chairman, thank you very much.

I am looking at some of your written testimony, Mr. McLure. Let me just read a couple quotes from that.

In your statement, you are talking about your survey. You said the work force is comprised of fewer than 5,000 full-performance level controllers than were present before the strike. It goes on to say, this controller workload will likely continue to be of some concern for some time to come. And furthermore, our survey showed that 70 percent of the radar controllers believe that they are required to handle more traffic during daily peak periods than they should be handling.

I assume that both you gentlemen heard the testimony earlier this morning when we were assured that everything was fine, that the morale of the traffic controllers really was good, although there were some complaints. I take it from your statement you do not necessarily agree with the more optimistic reports that we heard on the overall morale of the controllers?

Mr. McLure. Based on the questionnaire results, that is right.

Senator Exon. Now, let me ask this question. Did you specifically get into and has your study indicated any complaints, serious or otherwise, by the controllers on the change from the 4 hours on to 4 hours off, to the 6 hours on and 2 hours off?

Mr. Cotton. Our questionnaire asked them how much time they should spend working radar, working nonradar, getting trained, and taking breaks, and their response was that they should be working radar positions a little less than 4 hours in every 8-hour shift.

Senator Exon. In other words, they told you that they wanted to work, they felt they were at peak efficiency less than they were before the strike?

Mr. Cotton. Actually, they were saying it is 3.68, so they are saying approximately the same, yes. A little less.

Senator Exon. Then it would be safe to say that the switch from 6 hours on to 2 off is not something that they think contributes to airline safety the way it was presented to the committee this morning?

Mr. Cotton. Based upon their responses, correct.

Senator Exon. Madam Chairman, I think that's the key point, and when that came up this morning I thought that was a rather dramatic increase in the workload. I suspect that it was done, as I said then, from the standpoint that we can lick this union, and we can lick this union by having people work more hours, which increases productivity.

That sounds fine and good, so long as we are making no sacrifice on safety. I am not sure that that is the case.

One other point I would like to ask you about, and maybe it has come up in testimony already. I remain concerned not so much about the inspections that are provided by FAA on the major airlines, but I have a sneaking suspicion that the same scrutiny is not given to commuter airlines as is given to the major airlines.

Is there anything in your study or anything that has come to the GAO attention that would substantiate my suspicions?

Mr. Cotton. Part of our follow-on work in this area will address, will look at the differences between the part 121 carriers, the large airlines, and the smaller part 35 carriers. But for right now we have not reached any conclusions whatsoever.

Senator **Exon**. We will be looking forward to those conclusions. I think it would be very important to see what we have to do in this area.

Thank you, gentlemen. Thank you, Madam Chairman.

Senator **Kassebaum**. Thank you very much, Mr. McLure. We appreciate your testimony.

[The statement follows:]

Statement of Herbert R. McLure, Associate Director, Resources, Community, and Economic Development Division, GAO

Madam Chairman and Members of the Subcommittee, we appreciate this opportunity to comment on three safety issues relating to aviation—current conditions within the air traffic control (ATC) work force, variations in the type and frequency of the Federal Aviation Administration's (FAA's) inspections of air carriers, and FAA's progress in developing a terminal doppler weather radar system to detect and warn of low level wind shears. In the midst of civil aviation's worst year for fatalities, this hearing is particularly timely in that these three issues have become the focus of public attention and concern.

In response to several congressional requests we have, over the past year, initiated assignments addressing all three of these issues. My testimony today will summarize our findings and observations to date on each issue. We will then be available to participate in the respective panel discussions.

Aviation safety today relies heavily on the performance of people. The air traffic controller and the surveillance inspector are two critical human links in maintaining a safe national airspace system. The Department of Transportation (DOT) has recently announced substantial increases in both workforces. My comments today are intended to assist the Congress and FAA in determining what further actions appear warranted.

THE AIR TRAFFIC CONTROL WORK FORCE

FAA has been faced with an extraordinary challenge in rebuilding the air traffic control work force following the controller strike 4 years ago and the loss of so many experienced personnel. FAA's management of this recovery has been monitored by the Congress, particularly in light of FAA's goal of employing fewer controllers than before the strike while safely controlling increasing amounts of air traffic and maintaining harmony among controllers. In addition, airline accidents this year have fostered an atomosphere of increased concern over the operation of the air traffic control system.

Against this backdrop, we did a comprehensive and systematic survey of FAA's controller work force. We sent questionnaires to about 4,500 full performance level (FPL) and developmental controllers,[1] 1,000 first-line supervisors, and the managers at the 20 enroute centers and the 54 busiest terminal facilities in the continental United States to obtain their views and observations on several key topics, including controller work force staffing levels, composition, and attrition; air traffic activity and controller workload; overtime; sick and annual leave; training of new controllers; and FAA's automated operational error-detection program.

All told, we received about 4,200 responses by our July 26 cutoff date, for an overall response rate of 75 percent. We have, to date compiled the responses and I will provide some of the highlights for you today.

In addition to answering our questions, about half of the respondents provided narrative comments which we are just starting to analyze. We are also examining FAA data regarding staffing and the other topics covered in our survey in order to compare this information with the questionnaire responses.

Responses say system is safe, but raise concerns about maintaining safety

Most of the controllers, supervisors, and managers who answered our questionnaire rated the overall safety of the ATC system as adequate to excellent. Eightythree (83) percent of the controllers, 93 percent of their supervisors, and all the facility managers shared this opinion. Their responses, however, identified several safety-related concerns that appear inconsistent with this rating and must be addressed if the current level of safety is to be maintained.

---

[1] A full performance level controller is one who is fully certified to operate all positions in a defined area. The developmental controller is one who is undergoing training and those we surveyed have been certified to operate at least one radar position at their facility.

Staffing levels, composition, and attrition

As a result of the 1981 strike, the system-wide controller staffing level fell by 75 percent. The strike and dismissals resulted in the loss of about 11,700 controllers—9,200 of them at the full performance level. This left about 4,000 controllers, 3,400 of them at the full performance level, to operate the system.

The process of rebuilding the controller population has gone slower than FAA anticipated. For every 100 new controllers hired, barely half are able to remain and succeed in reaching full performance level status.

In June 1982, FAA said its goal was to have about 6,600 full performance level controllers by July 1984. But, as of June 1985 they were still short of the 1984 goal by 300. This is true even though a new controller can reach the full performance level in about 2 years. Before the strike, it took 4 to 5 years of experience to reach the full performance level.

The rebuilding process is also complicated by the fact that FAA may lose many of its experienced controllers and supervisors through retirement. About 15 percent or 570 controllers responded that they will be eligible to retire within 2 years and of that number 84 percent said they probably will retire. Percentage-wise, attrition of first line supervisors could be much greater. Of 880 supervisors responding, half said they will reach retirement eligibility within 2 years; of that number 81 percent said they probably will retire. Supervisors reported that they spend about 36 percent of their time actually controlling traffic.

Air traffic activity and controller workload

Respondents to our questionnaires also cited safety concerns about the level of air traffic activity and controller workload. The volume of air traffic has returned to prestrike levels but is now being controlled by a systemwide controller work force comprised of 5,000 fewer full performance level controllers than were present before the strike. FAA forecasts increases in air traffic and the first major labor-saving features of FAA's planned automated air traffic control system will not be available until at least the early 1990's. Thus, controller workload will likely continue to be a concern for some time.

Our survey showed that 70 percent of the radar controllers believe they are required to handle more traffic during daily peak periods than they should be handling. Their supervisors said that a much lower percentage—38 percent of the controllers under their supervision—are required to handle too much traffic, but even their estimate represents over 2,000 controllers. Facility managers, on the other hand, disagreed with both the controllers and supervisors stating that only 4 percent of the radar controllers are required to handle more traffic than the managers feel is appropriate.

Overall 86 percent of the supervisors, 91 percent of the controllers, and 72 percent of the responding facility mangers said that there are now fewer full performance level controllers than are needed. Moreover, 36 percent of the facility managers said their authorized level of such controllers is not sufficient. The majority of supervisors and controllers said that the current number of full performance controllers is having a negative impact on their ability to maintain a safe system. More than one-third of the facility managers also held that view.

Overall, 69 percent of controllers believe that the heavy workload is adversely affecting the safety of the system. For example, we asked questions about two air traffic control duties having a direct bearing on safety: responding to pilots' requests for traffic advisories and providing pilots with weather advisories. Even though about 26 percent of the controllers said they seldom, if ever, declined requests for traffic advisories, 32 percent said they often did. The overall situation was better concerning weather advisories in that 48 percent said they seldom, if ever, declined such requests, although 19 percent said they often did.

Training of developmental controllers

What about the quality of training received by developmental controllers? More than half the supervisors said the skill level of developmental controllers is having a negative effect on maintaining system safety; 45 percent of the controllers shared this opinion.

We asked controllers, supervisors, and managers to rate the quality of the on-the-job training that developmental controllers were receiving at their facility. Overall, facility managers rated the training as adequate to excellent. Again supervisors and controllers saw things quite differently. For example, in rating the quality of training for controlling traffic in bad weather, 35 percent of the supervisors and 55 percent of the controllers rated it less than adequate to poor. In another important skill area, knowledge of the operational characteristics of different types of aircraft, 34 percent of the supervisors and 42 percent of the controllers rated the training as less than adequate to poor.

Adding new controllers may not ensure system safety

Responses to our survey clearly indicated that controllers and supervisors believe that workload pressures are mounting to a point where it will be difficult to maintain the existing level of system safety. The recent DOT decision to increase the controller workforce by about 1,000 positions during fiscal years 1986 and 1987 on the surface appears to be a step in the right direction. But increasing the number of controllers represents only a partial, long-term remedy to the current conditions within the ATC work force. We believe that the low success rate of new controllers in reaching full performance level status, their low level of experience and training, and the loss of experienced staff through retirements also need attention if the existing level of safety is to be maintained.

VARIATIONS IN FAA'S INSPECTIONS OF AIR CARRIERS

In addition to hiring more controllers, DOT has also recently announced a planned increase in the number of FAA air carrier inspectors. These FAA inspectors monitor and inspect air carrier operations and maintenance practices to ensure compliance with Federal safety regulations and FAA-approved air carrier policies and procedures.

From fiscal years 1981 to 1984 the number of authorized inspectors decreased about 24 percent (from 674 to 508 inspectors) while the number of operating aircraft more than doubled. In fiscal year 1984 the Congress, concerned that these reductions could have long-term safety implications for the Nation's airlines, authorized an additional 166 inspectors to restore the work force to its authorized 1981 level. The Congress is presently considering adding an additional 200 inspector positions in fiscal year 1986.

Apart from the need for increased staffing, recent commercial aircraft accidents and the results of DOT and FAA studies have raised questions about how well the FAA inspector program is being managed. These studies showed that FAA regions do not interpret or apply FAA regulations and policies uniformly; that FAA offices do not communicate with each other effectively; and that FAA orders, handbooks, and other documents that guide inspections need to be revised and updated.

FAA has recognized the need to address these questions and has undertaken an extensive review of its management of air carrier inspections. Some congressional concern has also been expressed over whether FAA should be hiring new inspectors until there is adequate analysis of FAA's current inspection program and staffing standards.

GAO's August 1985 inspector report

At the request of two House Subcommittee Chairmen, we compiled and analyzed data on the type, frequency, and results of fiscal year 1984 inspections covering air carrier personnel, aircraft, and maintenance and other facilities for a sample of 92 of the nation's approximately 500 scheduled commercial air carriers.[2] We reviewed about 12,000 reports of avionics (aircraft electronics), operations, and maintenance inspections.

Comparison of operating hours and FAA inspections

To compare FAA's inspections, we grouped the air carriers according to their fiscal year 1984 operating hours. We found that some air carriers with a similar number of operating hours had significant differences in the total number of FAA inspections, and some air carriers with similar numbers of FAA inspections had large differences in total operating hours.

For example, an airline with about 41,000 operating hours had 571 FAA inspections whereas another airline with about a thousand more operating hours had only about one-third that number of inspections. Conversely, an airline with about 90,000 hours received 274 inspections, whereas another airline with about 56 percent more hours received the same number of inspections.

---

[2] Compilation and Analysis of the Federal Aviation Administration's Inspection of a Sample of Commercial Air Carriers (GAO/RCED-85-157, August 2, 1985)

Some air carriers had no avionics or operations inspections

Our review also showed that 29 air carriers (about 32 percent of our sample) had no FAA avionics inspections during fiscal year 1984. Four air carriers did not receive any FAA operations inspections. Two of the air carriers received neither an avionics nor an operations inspection. Twenty-five of the air carriers (86 percent) that did not receive avionics or operations inspections had their operating certificates in FAA's Alaska or Southern regions and almost all were small air carriers.

Variances among FAA regions

Our review found that FAA regions varied in the proportion of operations, maintenance, and avionics inspections they performed, and in the percentage of inspections that resulted in unsatisfactory ratings for the carrier. For example, we found that in 4 of the 5 regions we visited, about 87 to 92 percent of total inspections were operations and maintenance inspections while the remaining 8 to 13 percent were avionics inspections. In the other region we found a relatively even distribution among operations, maintenance, and avionics inspections.

Similarly, we found variances in the results of FAA's inspections of air carriers among the five regions reviewed. Unsatisfactory operations inspections ranged from 3 to 11 percent, unsatisfactory maintenance inspections varied from less than 1 percent to 24 percent, and unsatisfactory avionics inspections ranged from 1 to 9 percent.

FAA's response to GAO's report

FAA has stated that they found our report to be very beneficial in that it gave them an independent and different perspective. FAA also indicated that there are valid reasons for some of the variances we found among the carriers in our sample. According to FAA, comparing FAA inspections with fleet operating hours, alone, should not be used to assess FAA surveillance performance. FAA believes other factors, including fleet size, aircraft type, age of the carrier, expansion rate, and history of regulatory compliance, should also be considered. Nevertheless, FAA said it has begun to improve the inspection program by correcting staffing deficiencies and implementing guidelines which specify minimum numbers of inspections. According to FAA, these and other implemented or proposed changes will restructure and revitalize their inspection program.

GAO's follow-on review

At the request of the two House Subcommittee Chairmen who had requested the basic inspection data presented in our August report, we have begun a review to determine the reasons for the variations in FAA's inspections of air carriers as well as the adequacy of FAA's implemented and proposed changes to its inspection program. They have also asked us to address other issues that reach beyond the adequacy of the number of FAA inspectors. These include the adequacy of FAA's standards, guidance, and priorities for air carrier inspections and surveillance and the extent to which they are being followed; the reasons why FAA generally does not know how often an air carrier is inspected and whether it is receiving sufficient inspections; and the reasons why violations of federal aviation regulations have gone undetected for long periods of time for some carriers and why detected problems with some carriers continued to go uncorrected.

We plan on completing our work on this request next spring.

FAA'S TERMINAL DOPPLER RADAR EFFORTS

In summarizing our observations on the third safety-related issue—FAA's efforts to develop a terminal doppler weather radar system to detect and warn of low level wind shear—I would like to return to the response of controllers to our question on providing pilots with weather advisories. About one out of every five acknowledged that they often decline to provide pilots with weather advisories while working daily peak traffic periods. This may be important if advisories are not given in severe weather conditions.

In March of this year, we began evaluating FAA's research efforts to develop a terminal doppler weather radar system. We are reviewing the status of research activities conducted under several FAA contracts related to terminal doppler radar development and the wind shear hazard.

My statement today is based on this ongoing GAO work. On July 19th, we met with the Administrator of FAA to share our observations and suggestions relating to FAA's terminal doppler efforts. Subsequently, the crash of Delta Flight 191 at the Dallas/Ft. Worth airport heightened congressional concern about the wind shear hazard to aviation and FFA's progress in developing a terminal doppler radar. Our ongoing work provides insight on (1) the difference between the terminal doppler radar and the next generation weather or NEXRAD radar, (2) the status of the two radars' development, and (3) other measures FAA can take to increase safety by minimizing the risk associated with wind shear.

Differences between NEXRAD and the terminal doppler radar

NEXRAD and the terminal doppler radar differ in both their purpose and their technical requirements.

The NEXRAD is a long-range (145 to 290 miles) weather surveillance radar. Its purpose is to identify severe storms as part of the national weather needs of the Departments of Commerce, Transportation, and Defense which are jointly funding its development. NEXRAD doppler characteristics are to identify very large wind shear formations, like tornadoes, gust fronts, and severe air turbulence, as well as precipitation normally associated with severe storms. National Weather Service radar meteorologists operating NEXRAD will provide enhanced aviation weather information, but they will not address airport wind shear hazards.

The terminal doppler is to be a short-range (12 miles) radar. Its purpose is to detect small, low wind shears, including extremely violent, rapidly developing, vertical wind shares called microbursts, in the approach and takeoff glide paths around airports and rapidly warn controllers. In these areas, aircraft are close to the ground and pilots have little time to adjust to abrupt changes in air speed. Research to develop this radar and its displays to warn controllers is being conducted under contract with FAA by the National Center for Atmospheric Research (NCAR) and MIT's Lincoln Laboratory as part of the NAS plan.

Because of their different purposes, NEXRAD and terminal doppler radars have different technical requirements especially clutter suppression, data updating, and automation. Because NEXRAD radars are long-range components of a national weather network, each can be located with some local flexibility in order to minimize signal interference from aircraft and other radars and from "ground clutter" such as buildings and other obstructions. Conversely, terminal doppler radars must be located on or near airports in order to identify rapidly developing microbursts in the glide paths. Ground clutter and signal interference at the airports are likely to be a major problem. Thus, a terminal doppler radar may have to have more signal interference and clutter suppression capability than a NEXRAD.

Further, since some microbursts can become hazardous very quickly, terminal dopplers must be able to provide new information on the entire terminal coverage area very rapidly. Radar data must be updated every minute in order to provide adequate advance warning. In contrast, NEXRAD will provide updated information to meet long-range weather detection needs every 5 minutes.

In order for a terminal doppler weather radar to provide adequate advance warning, FAA says that it must be fully automated because there are no radar meteorologists to interpret the data from the doppler radars and warn controllers of wind shears. FAA also believes there is only about 45 seconds total operating time to identify a wind shear and provide a warning. Since NEXRAD will be operated by National Weather Service radar meterologists and its data are not as time critical, it does not require a fully automated system.

Status of the two radars

Solutions to the technical requirements of terminal doppler radars depend on further research and development. More specifically, FAA plans to continue the research of Lincoln Laboratory on radar siting and wind shear detection capabilities and of NCAR on controller wind shear displays through 1987.

In contrast, the NEXRAD radar program has reached the procurement stage. Prototypes have been developed by two contactors and are being tested. Once tests are completed and the results evaluated, FAA plans to award a limited production contact in September 1986 to operationally field test 10 radars, with delivery of these radars beginning late in 1988. Plans are to award a full scale production contract for about another 150 radars in 1987 with delivery from 1989 through 1993.

Martin Marietta, FAA's NAS plan System Engineering Integration Contractor, estimates that a prototype terminal doppler radar could be tested in 1988, with an operational radar delivered by July 1990. FAA believes that this proposed schedule may be close enough to the NEXRAD schedule to permit adding the terminal doppler radar procurement to the NEXRAD contract. If this could be done, Martin Marietta claims that about 3 years could be saved simply by avoiding repeating the first two key decision points of OMB A-109 competitive selection process.[3]

---

[3] There are four key decision points in the A-109 process—exploration of alternative systems, competitive demonstration, full-scale development/initial production, and full-scale production.

The most recent information which we have seen, however, clearly indicates that the NEXRAD and terminal doppler radar schedules are not in the same phase of development. As stated previously, technical solutions to the terminal doppler radar's clutter suppression, data update rate, and fully automated warning capabilities, have not been devised. According to FAA officials, they are now considering a different antenna, a different frequency band, and a different beam width than the NEXRAD radar in order to address these technical requirements and its planned research will not be completed until 1987, a year after the limited NEXRAD production contract is to be awarded.

GAO's observations of FAA's efforts to develop a terminal doppler radar

At our July 19th meeting with FAA's Administrator, we identified three issues where FAA actions were critical to improving terminal doppler radar efforts—sitting priority, operational testing, and reducing costs. For each issue, we suggested actions FAA might take and asked the agency to respond to our suggestions.

Wind frequency data are required to establish siting priorities

First, adequte national data on wind shear frequency are not available to establish siting priorities. Aside from data relating to thunderstorms in the summer months, FAA has aggregate time series data on the number of wind shear occurrences for only four airports. Therefore, FAA does not know at which airports wind shears occur most frequently.

Several years ago, the National Academy of Sciences, the National Transportation Safety Board, and NCAR cited the need for such data and suggested using the existing Low Level Wind Shear Alert System (a network of ground based wind sensors on an airport joined to a small computer to show when there are divergent winds) to collect it. These systems are presently installed at 59 airports, and will soon be installed at 110 potential terminal doppler radar airports.

Because FAA had not collected these data, we suggested to FAA's Administrator that FAA use the existing Low Level Wind Shear Alert System to develop wind shear frequency data. FAA has now agreed to use these systems to collect frequency data to supplement the traffic and thunderstorm activity data it presently uses to site wind shear detection and warning systems.

Initial production units should be tested in an operational environment

Second, FAA's planned efforts to expedite terminal doppler radar procurement do not include time to test and evaluate initial production units in an operational environment. A fully automated research doppler radar operating without a meteorologist to interpret the data and warn controllers is to be tested in Denver in 1987.

The integration of an automated terminal doppler radar warning system is extremely complex. Microbursts must be detected by a radar, interpreted by a computer, and warnings issued to a controller who must rapidly relay the warning to a pilot. Because of the complexity of the system and the life-critical decisions a controller and pilot must make relying on a terminal doppler radar, we suggested to FAA that initial production units be tested and evaluated in an operational environment to ensure effective performance. FAA is confident, however, that the operational aspects of the system can be thoroughly developed through research testing.

A study by an FAA contractor of several major systems acquisitions said that failure to adequately test operational systems in the field prior to full procurement is a major cause of subsequent performance problems. This supports our belief that operational testing of initial production units is crucial.

Terminal doppler radar costs should be re-examined

Third, althought siting criteria based on the traffic levels, thunderstorm frequency, and low level wind shear alert system data may support installing terminal doppler radars at a large number of airports, the results of a benefit-cost analysis suggest a more limited deployment unless the doppler's cost can be reduced. The life-cycle cost of each terminal doppler radar is $4 million. Using this cost, Martin Marietta found that less than 15 airports had positive benefit-cost ratios when considering only the safety-related benefits. When efficiency-related benefits wre added to the analysis by assuming that terminal doppler radars would reduce thunderstorm-related delays by 5 to 10 percent, 15 to 27 airports showed sufficient net benefits to justify their installation.

Martin Marietta added the positive net benefits from the 15 to 27 airports to the benefit-cost ratios of airports with negative net benefits. This approach increased the number of airports where the radars appear justified to between 41 and 101.

We understand that Martin Marietta has recently revised its benefit-cost ratios to include a higher technical and schedule program risk and to capture the effects of the recent crash of the Delta flight at the Dallas/Ft. Worth airport. The former would tend to reduce costs by having FAA assume a greater risk of failure while the latter would tend to increase program benefits by including the lives and aircraft lost in the Delta crash. This could increase the number of airports having positive benefit-cost ratios. We have not had an opportunity to review Martin Marietta's revised analysis.

We agree with FAA that terminal doppler radars should be installed at airports when frequency data indicate wind shear to be a hazard to aviation. However, we also support the rationale that program funding should be based on the safety and efficiency benefits to be derived. Rather then manipulate the benefit-cost justifications, we urged FAA to re-examine its cost-driving requirements in an effort to reduce the cost of terminal doppler radars.

FAA disagreed with us, citing Martin Marietta's conclusion that FAA's preferred radar would be the optimum system and the most cost-effective. However, Martin Marietta's conclusion was not based on a review of the terminal doppler radar's cost-driving requirements. Rather, the requirements were held constant and Martin Marietta based its conclusion primarily on the assumption that FAA's preferred terminal doppler radar will be added to the interagency NEXRAD procurement contract.

Martin Marietta believes that 3 years could be saved by avoiding repeating the first two key decision points of the OMB A-109 process. As we have pointed out earlier, this assumption may not prove accurate since the NEXRAD and terminal doppler radar schedules are not now in the same phase of development and FAA has not yet found solutions to the terminal requirements that differentiate the terminal doppler radar from NEXRAD.

FAA's Deputy Associate Administrator for Engineering testified before the Congress that development of alternative designs for a terminal doppler radar is being initiated and that FAA is looking at alternative ways in which to make the appropriate acquisition. According to the Director of the NEXRAD Joint System Program Office, NEXRAD's cost-driving requirements were re-examined in June 1982. The re-examination resulted in reduced system requirements and revised cost proposals. We believe that a similar re-examination could result in reduced system requirements and revised costs for terminal doppler radars.

Other measures

There are also other measures FAA can take to increase safety by minimizing the risk associated with wind shear. In March of this year, the National Transportation Safety Board issued a report identifying 34 wind shear-related recommendations made by the Board to FAA over the last 10 years. While FAA has acted on some of these recommendations, a number remain open. They include the need to evaluate methods and procedures for using current weather information as criteria for delaying arrivals and departures in severe weather conditions; the need to develop training aids such as educational video tapes for pilots and controllers and to encourage air carriers to provide their pilots with simulator training that incorporates microburst models for avoiding and escaping wind shears; and the need to promote development of airborne wind shear detection devices as well as airborne flight management systems to detect and escape wind shear.

Martin Marietta calculated that about 29 percent of all aviation wind shear accidents would still occur even with a fully automated terminal doppler system. Therefore, providing pilots with the training needed to take preventive or evasive action could be a top priority. Accordingly, FAA is planning to award a contract to a consortium of aircraft manufacturers, airlines, and scientists for the development of an improved pilot training program on wind shear. This program is to be conducted over a 2-year period and will provide training suitable for all categories of pilots.

This concludes my testimony Madam Chairman. I will be happy to answer any questions you may have at this time.

Senator KASSEBAUM. At this time, we would like to hear some testimony from one of the committee members, Senator Gore.

STATEMENT OF HON. ALBERT GORE, JR., U.S. SENATOR FROM TENNESSEE

Senator GORE. Thank you, Madam Chairman.

I am not a member of this subcommittee, but I appreciate very much your willingness to allow me to offer some thoughts here.

I have three reasons for indulging this subcommittee's time. First of all, as a former Member of the House of Representatives on the Science and Technology Committee, I chaired a rather lengthy investigation into this same matter 3 years ago.

Second, some of the cutting edge research is being done in Tennessee at the Memphis Airport, and I have familiarized myself with that work fairly thoroughly, and I want to offer the committee some thoughts as a result.

Third, I previously introduced legislation in the Senate, S. Con. Res. 66, calling, having to have the Senate call for the purchase and deployment of Nexrad without any further delay.

So, let me just run through those three items briefly. But by way of introduction, some of this may be repetitive, so I will condense it briefly.

It is no secret that weather is the major obstacle now to safe air travel. Nearly 50 percent of all air accidents are caused, either wholly or in part, by weather, and wind shear is probably the greatest single hazard we are not dealing with adequately. Wind shears of varying types have caused some 27 accidents and 500 air fatalities in the last 20 years, and it seems that in all probabilty the victims on board Delta flight 191 in Dallas in July will be added to that list.

It was partly as a result of this history that I chaired the hearings to which I referred a moment ago and conducted the investigation in the House. This was right after the crash of Pan Am's Boeing 727 in New Orleans. We heard a lot of alarming testimony at that time, including the fact that the FAA had no single official with designated responsibilty for weather-related accidents and for weather, and the FAA changed that situation at the urging of the committee.

There was positive news, as well, in the testimony of the FAA, NOAA, and other interested parties about the promise they saw in Doppler radar as a means of detecting wind shear. The agencies felt at that time that incorporating Doppler into the next RAD Program would one day lead to a national system in which controllers and pilots would have up-to-the-minute data on their screens in order to avoid wind shears and microbursts and protect their passengers.

Indeed, the FAA's research venture with NOAA was imminently successful, as Doppler has proved to be a viable technology for keeping track of wind shears. The testing conducted at Memphis International Airport has also been of enormous importance, and they are having great success developing Dopplers that can give airport air traffic controllers the information they need on wind shears.

Since most of these wind shear accidents have occurred during takeoff or landing, this has been a crucial part of the Government's efforts to eliminate the safety problem posed by wind shear.

The experiments at Memphis are also proving surprisingly successful at developing high quality software of the kind that has been referred to and of the kind that is greatly needed. For example, in Memphis they can now successfully filter out the so-called noise from auto traffic and buildings, and the scientists feel that these experiments might soon take us one step further and give us the capability not only to quickly detect wind shear but also to predict wind shear, because they are developing a voluminous computer base about the conditions immediately prior to wind shear phenomenon, and they believe they can make flying much safer with these new developments.

Moreover, the technology being developed in Memphis would also solve the problem raised by the National Transportation Safety Board's revelations yesterday concerning the crash in Dallas. It has been a persistent problem to get integrated, up-to-the-minute weather data to the controllers and pilots.

The Memphis Nexrad experiments will make it possible, when the technology is fully developed, to put the information on thunderstorm activity right on the airport controller's screen, so then the individual who is busy talking a pilot through his landing would have the data he needs in front of him and would not have to wait for a weather observer who calls the tower too late or for another aircraft to experience the wind shear but never calls.

We can all feel the intense sadness and regret that these calls are not made just at the right moment, but really if you take a broader view of it, it is almost unfair to expect these people to operate like machines and do everything right and put this heavy guilt on them individually for not doing what a computer is much better designed to do. What we have the ability to do with computers right now will soon be operational, and we need to start the procurement process right now so that there will not be any further delays.

The system that currently exists obviously cannot rely on separate slow and unreliable sources to steer pilots away from wind shear, and the Nexrad Program will go a long way toward solving that gap in the system.

Now, because of the promise involved here, one would assume that if the research is done properly and the technology has been developed which would greatly reduce the risk to the flying public that we would deploy the technology as quickly as possible. Given the Government's sizable investment here and FAA and NOAA's successful research, the fact that the money is in the trust fund to pay for it, the only logical course would be to move forward with all reasonable speed.

Inexcusably, this has not been the case, and much of the blame belongs with the Office of Management and Budget. Let me make it clear that, you know, nothing would have prevented those accidents that have occurred recently because it is not there yet, but accidents that will take place in the future because of delays could be avoided.

Now, just as the Nexrad Program was paying off and we were ready to reap the benefits of this research, OMB said, in essence, wait, delay, let us see if we can save some money by buying off-the-shelf technology. Now, what is wrong with that, Madam Chairman, is that the scientists and technicians at FAA and everywhere else where they were aware of this knew that there was no off-the-shelf technology available.

Now, under the guise of fiscal responsibility, OMB made a very poor decision, and in my opinion the delays that OMB has placed on the Nexrad Program are simply unacceptable. Let me just give you the bare facts as I understand them as to why we must proceed with procurement now.

In January 1986 Raytheon and Sperry are going to have their competition. In the spring of 1986 the process will be kicked into gear as the decision is made. Now, both the FAA and the National Transportation Safety Board feel that it is much better and we can save a lot of time and very possibly a lot of lives by beginning the procurement process now so that we can fine tune the computer software while the hardware is being developed or finalized.

We can condense the development time and compress the timetable and shorten the time at which this thing can be operational. They believe it can be operational in 1988 or 1989, as Mr. Burnett stated. If we delay the procurement process, we run the risk of further accidents.

Let me say parenthetically, I do not know if he has left the room, but I think he has been doing an absolutely outstanding job at the NTSB, and we ought to listen to him when he talks about issues like this. When he and his staff and the FAA and their staff agree that we can save lives by compressing this process and starting the procurement now, let us by all means take their advice and do it.

I thank you for allowing me to encroach on the subcommittee's time. Though I am not a member of the subcommittee, I am very, very interested in this subject, and I applaud your efforts and those of the subcommittee in trying to make certain that there are no unreasonable delays in this lifesaving program.

Thank you.

Senator **Kassebaum**. Thank you very much, Senator Gore, for your expertise.

I would just like to hear your opinion on whether it is in fact possible to incorporate the terminal Doppler system with Nexrad. GAO seemed to question whether this was possible. Now, I gather from what you say that you see no problem with the compatability of the two systems?

Senator **Gore**. I believe they also disclaimed some measure of technical competence in responding to those questions. Certainly, I have to do the same, even more so than they do.

But I have talked with the scientists and the engineers at Memphis and at the FAA and at the NTSB, and I am impressed, Madam Chairman, that there is such strong agreement among the experts in these agencies that it can be done. Since the risk is there, and since the opportunity to save lives is there, it seems to me we ought to take the advice of the experts.

I personally believe, and it is my understanding that the consensus in the scientific community also is, that the GAO is unduly pessimistic about this technology.

Senator **Kassebaum**. Thank you very much.

Any other questions?

Senator **Ford**. Let me just ask one quick question. You are telling this committee that in your judgment we could improve upon the 1992 deadline that we have had here today by several years?

Senator **Gore**. Senator Ford, I believe, based on lengthy study of this technology dating back 3 years, numerous conversations with the experts in the field, that this system could be operational by

1989 or early 1990 if we compress the procurement process and simultaneously fine-tune the software and the hardware.

Senator Ford. But GAO just told us it could be used now if we had the meterologists to sit there and transmit the information, but we do not have them so they are depending on the so-called software to put it all together and do it somewhere in the neighborhood of 45 seconds to a minute.

Senator Gore. The experiments in Memphis have made much more rapid progress in the development of the software than was believed to be possible. They have surprised themselves at how quickly the data base has grown and the insights they have gained and the innovations they have been able to come up with in fine-tuning the software already.

Senator Ford. Madam Chairman, do we have the ability to secure the data from Memphis?

Senator Kassebaum. I suppose that we do. The FAA, I assume, is monitoring this data.

Senator Gore, have you——

Senator Ford. My question is, if the reservations we have had today and the careful approach they are looking at can, with scientific data, be improved considerably and we have that data laying out there that we ought to be able to make a judgment with, I'd like to have the ability to at least read the data secured at Memphis and glean from that, if I can, the statement that Senator Gore made that we can accelerate it by, we are looking you say a minimum of 2 years, and we are putting the Doppler system in with the software right behind it.

Apparently, the software is what they have made such giant strides with.

Senator Kassebaum. Let me just say I think there will be some people testifying on the wind shear panel who can help answer some of these questions, too.

Senator Gore, did you have——

Senator Gore. No, I was just going to say the data is voluminous there, and it would have to be condensed, but I feel certain that those involved in the project would be more than happy to provide a condensed summary of it to the subcommittee.

Senator Kassebaum. Thank you. Thank you very much, Senator Gore.

I very much appreciate the members of panel 1, the Wind Shear Panel, being willing to accommodate panel 2, which we will hear from first due to some time constraints on some of those testifying. So, we will make that change. Would those who will be testifying on panel 2 please come forward?

If you don't know who you are, that's Jack Ryan of the FAA; David Kelley of the NTSB; Joe McGrail, GAO; Captain McNair, ALPA; Roger Fleming, ATA; Larry Jones, the chairman of the special task force and president of the Coleman Co.

[Pause.]

Senator Kassebaum. It is a pleasure to welcome the panel, and I appreciate the patience of everybody who has waited through this morning's hearing.

Let me just say for the panel discussion, we are going to limit the time for witnesses whose agencies or departments have not previously testified to 4 minutes and our questioning to 4 minutes.

Now, I hope that we can keep it rather informal. We now have some background on what we will be discussing. Those whose organizations have not yet testified who are part of this panel are Captain McNair of the Airline Pilots Association; Roger Fleming, senior vice president, technical services, ATA; and Larry Jones, who chaired the special commission analyzing the air traffic control system in 1982, and a further review in 1984. He is chief executive officer for the Coleman Co. in Wichita, KS.

I would like to start with you, Mr. Jones, since you have conducted some extensive observations of the air traffic control system.

STATEMENTS OF LARRY JONES, CHAIRMAN, DEPARTMENT OF TRANSPORTATION, TASK FORCE ON MANAGEMENT AND EMPLOYEE RELATIONSHIPS; J. ROGER FLEMING, SENIOR VICE PRESIDENT, TECHNICAL SERVICES, AIR TRANSPORT ASSOCIATION; LOU McNAIR, EXECUTIVE CENTRAL AIR SAFETY CHAIRMAN, AIR LINE PILOTS ASSOCIATION; JACK RYAN, DIRECTOR OF AIR TRAFFIC OPERATIONS, FEDERAL AVIATION ADMINISTRATION; JOSEPH M. McGRAIL, EVALUATOR-IN-CHARGE, GENERAL ACCOUNTING OFFICE; AND DAVID R. KELLY, CHIEF OF OPERATIONAL FACTORS DIVISION, BUREAU OF TECHNOLOGY, NATIONAL TRANSPORTATION SAFETY BOARD

Mr. Jones. Thank you. I have had the opportunity, Madam Chairman, of testifying to the committees over the past because the work that the task force began immediately after the PATCO strike in the fall of 1981 included the filing of the report of our findings and recommendations in the spring of 1982, a follow-up report on that by the task force in the summer of 1983, and after some more extensive review, again a follow-up in the summer of 1984.

I make only two brief comments. I have had the opportunity to hear the testimony this morning, and thus I hope I can brief my comments to the points that seem pertinent to your committee.

Basically, I believe it is recalled that our report documented the fact that about the time of the PATCO strike in the fall, in August 1981 the attitudes of the people within the FAA particularly relevant to the air traffic control segment immediately prior to the strike and at the time of the strike were what I think anyone would categorize as not good. Morale was bad.

If we could attempt a summary of those many pages of findings, it revolved that poor morale primarily around the attitude that work within the FAA that within the management systems and within the management group itself there was little concern expressed for people, and employees of the organization, both including the controllers clear through the facility managers took offense at that.

We revisited, of course, that question of morale in the summer of 1984 and found in essence, as we reported then, that things were about as bad in the summer of 1984 as they had been prior to the strike in 1981, despite the fact that in our judgment the FAA had initiated many activities and actions, personnel changes, system changes, that were designed to correct that problem of having an inadequate concern for people.

The poor morale in the summer of 1984 as we found, and our work was in conjunction also with a survey being taken within the FAA by its own profession, that we could simplify again the reason for the poor morale in the summer of 1984 seemed to rest around the fact that the employees could see and feel a wave of traffic coming at them through the rebirth of growth in the commercial traffic system, and it was their judgment, those people at work, that we weren't prepared to handle it well.

So, the focus of the morale has changed as we found it between that which existed that may have precipitated the strike in 1981 and that which we found to exist in the summer of 1984. Not so much in 1984 that there was no concern for people, but that we were just not adequately prepared to handle the work we had.

I would want to point in conclusion that our original report in 1982 attempted to make a point that you can't separate this question of human relations and morale and working relationships from the work itself. Our report, I think, documented extensively the fact that when we looked at the work itself and looked at an awful lot of things, at least it was our judgment, we discovered that this thing called a variability factor was the single most significant thing we could find.

That means that we found by measuring in a large number of sample of facilities, the peak traffic as measured against the lowest level of daily traffic in that very facility, we call that a variability index. And every troublesome factor we had any data base to associate that variability factor with turned out to be positively correlated.

In other words, we found that the higher that variabiltiy index, the difference between the peak load and the valley load, daily basis, each facility, the greater that difference, the more there was a positive correlation with the poor morale that we found in our questionnaires and our interviews; with the filing of grievances in that facility in the prior year; with system errors that were reported in that facility; with the percentage of people that participated in the strike in August of that year; with early retirement records; and with the extent to which medical leaves had been taken by the employees of that facility.

And I can only conclude without knowing that the emphasis within commercial aviation on hubbing probably, undoubtedly has created a situation whereby that variability factor, difference between peaks and valleys at many, many of our facilities, perhaps the system as a whole, is of greater extent today than it was then, and I would know no reason why any factor that your committee might be concerned with about the FAA and the air commercial system wouldn't be under more stress today than it was then.

So, I think this question of peaking and its relationship to the valleys of traffic in the day just would be a subject that I would encourage you to pursue.

Senator **Kassebaum**. Thank you very much.

We will, I think, hear everybody else and then come back for some questions.

Mr. Fleming, Air Transport Association.

Mr. FLEMING. Thank you, Madam Chairman.

I have a prepared statement. I would ask with your permission that it be included in the record of proceedings.

Senator KASSEBAUM. Without objection.

Mr. FLEMING. Thank you. I would like to express my appreciation for the opportunity to appear here today to emphasize the airlines' highest priority commitment to safety and to discuss with this committee areas of mutual interest regarding aviation safety in this country. We have a proud record of achievment, and we want to do all that is necessary to ensure that this remains so in the years ahead.

I said mutual interest to emphasize that member airlines of the ATA share the view of committee members that more can be done to improve the safety and efficiency of what is already the safest and most efficient air transportation system in the world. We have already heard a great deal of testimony about some of the things that may be done.

Air transportation in this country stands now at an unprecedented level. Passenger traffic this year has established new records, and I would note that this past summer was the busiest in airline traffic in the history of U.S. aviation, bearing up what Mr. Jones just said. Through August this year, traffic is up in terms of passengers carried about 13 percent compared to the same 8-month period last year.

Public interest in safety has increased this year, because there have been fatal accidents involving both domestic and foreign carriers, most operating U.S. manufactured airplanes. The FAA has stated, and the airlines agree, that there does not appear to be any link or common factor among the accidents that have occurred this year.

Some press attention has speculated upon airline deregulation as a cause of this year's increased toll of airline fatalities. You have already heard from other witnesses that the facts do not support this.

The period from 1979 to 1984, representing the first 5-year period of deregulation, has been the safest 5-year period since the jet age began more than a quarter century ago.

Turning now to operation of the air traffic control system, the ATA member airlines, which are major users of the air traffic control system, believe the air traffic control system is safe. It is not, however, being staffed to efficiently handle the growth expected in air transportation in the near term. The ATC system has maintained its safety margins since the controllers strike of 1981 by slowing down traffic and limiting access to the system.

Those techniques continue to be refined by FAA and employed as necessary. Mr. Ryan, sitting at my right, has a very competent staff of people who work with airlines to accomplish those objectives. We believe these restrictions would probably not be necessary as frequently as they are employed if the controller work force were larger and more experienced. The experience level will come with time and with increased emphasis on using all available resources to help meet on-the-job training requirements, such as the increased use of retired annuitants and part-time controllers. And we heard again this morning that there is evidence that some controllers eligible for retirement now might be willing to work in that fashion.

The airlines believe the size of the work force can and should be increased, and we have recommended in the past, as you know, that the FAA Administrator be given the flexibility to hire additional controllers.

We would like to take this opportunity to commend Secretary Dole and Administrator Engen for announcing decisive action to strengthen the air traffic control system by the addition of nearly 1,000 controllers over the next 2 fiscal years. Recognizing that it takes approximately 3 years for a new-hire controller to reach fully qualified status, the augmentation of the ATC system announced by DOT is an important step in helping to assure that the Nation's aviation needs in the years ahead will be met safely and efficiently.

In the other areas of air traffic control, much interest has been expressed in the traffic alert and collision avoidance system under development by FAA. Adminstrator Engen spoke of that program this morning. There are a number of technical hurdles that remain to be cleared before it is ready for use. In the meantime, the airlines believe a meaningful safety enhancement could be realized through the carriage of altitude encoding transponders by a signficant percentage of the aircraft population operating in busy terminal air space.

Increased carriage and use of this equipment would improve air traffic surveillance in these busy areas. ATA will soon submit a proposal to FAA to pursue that objective. That completes my statement, Madam Chairman.

[The statement follows:]

Statement of J. Roger Fleming, Senior Vice President—Technical Services, Air Transport Association

Chairman Kassebaum and distinguished committee members, I am Roger Fleming, senior vice president—technical services for the Air Transport Association, which represents U.S. scheduled airlines. I am accompanied by Richard D. Tabery, senior vice president—maintenance operations for United Air Lines. I want to thank you for the opportunity to appear here today to emphasize our highest priority commitment to safety, and to discuss with this committee areas of mutual interest regarding aviation safety in this country. Aviation safety has a proud record of achievement, and we want to do all that is necessary to ensure that this remains so in the years ahead.

I said "mutual interest" to emphasize that member airlines of the Air Transport Association share the view of committee members that more can always be done to improve the safety and efficiency of what is already the safest and most efficient air transportation system in the world.

Air transportation in this country stands now at an unprecedented level of achievement and service to passengers and shippers. Passenger traffic this year has established new records, with more than a million passengers a day traveling on U.S. scheduled airlines. This past summer was the busiests in airline traffic in the history of U.S. aviation.

Thus, more people are flying, and they are continuing to fly in great safety. In the past three years, there have been a total of three fatal accidents involving jet airplanes operated by U.S. airlines. They occurred this year in disparate areas and circumstances.

In the airline industry, we consider even one accident one too many. Our goal is the record that produced 30 months of flying by ATA members without a single fatality in the period from August 1982 to January 1985.

Public interest in safety has increased this year because there have been fatal accidents involving domestic carriers and foreign carriers, most operating U.S.-manufactured equipment. The FAA has stated, and we agree, that there does not appear to be any link or common factor among the accidents that have occurred this year. The Air India 747 that went down in the Irish Sea is unexplained, although a terrorist's bomb is suspected. The crash of the Japanese 747 is still being investigated in an effort to determine what caused the damage to its flight controls. Although the British 737 and the Midwest DC-9 accidents involved the same engine type, the circumstances of the two accidents were entirely different, the nature and causes of the engine failures were completely different, and no common factor seems present.

Some press attention has speculated upon airline deregulation as a cause of this year's increased toll of airline fatalities. The facts do not support this. The period from 1979 to 1984—representing the first five years of deregulation—were the safest of any five-year period since the jet age began more than a quarter-century ago. Transportation Secretary Elizabeth Dole took note of this recently. Secretary Dole said, "Even taking the recent tragic airline accidents into account, the accident rate for airline travel has declined steadily over the past decade."

This committee has requested industry views on several important areas of air safety, including wind shear. We know that wind shear has caused several fatal accidents in recent years and that it has been reported to have been a factor in the L-1011 crash in Dallas this year. Thus, we welcome the committee's emphasis on wind shear during this hearing, and appreciate the opportunity to provide our views on this potentially violent—sometimes fatal—phenomenon of nature.

We are also pleased to offer our comments on the other important areas of committee interest—air traffic control, and FAA inspection and surveillance. In all these areas, as indeed in every aspect of air safety, the ATA member airlines are guided by what always has been and continues to be their paramount consideration—the safety of public air transportation.

SEVERE WEATHER DETECTION AND AVOIDANCE

Bad weather adversely affects aviation safety to the extent that aviation operators are uniformed as to its true nature and location. That means that detection and dissemination of timely and accurate weather information must be the focus of our efforts in this area.

Government and industry need to improve both the quality of weather information products, including short and long-term forecasting, and the communication of those products to the people who need them most of all—the flight crews.

Technology such as Doppler radar will play an important role by providing timely warning of developing hazardous weather conditions. That is why we have, over the years, supported funding for its development and deployment. But we must not overlook other near-term opportunities to improve the quality of weather information provided to flight crews.

One example of positive government and industry cooperation in this area is a special group established within the last year by the FAA known as the Aviation Weather Forecasting Task Force. It is chaired by Dr. John McCarthy of the National Center for Atmospheric Research and is a joint venture with the National Weather Service. Airline representatives contribute to the ongoing task force inquiries.

Among the important topics the task force is examinig are: better utilization of pilot reports to increase the amount of information available concerning such things as enroute winds and turbulence, an evaluation of certain critical aviation weather products such as terminal forecasts, SIGMETS (Significant Meteorological Information) and convective SIGMETS, area forecasts, and center weather advisories. The task force is also examining areas such as aviation meteorological training, private weather services and special weather research programs.

An important focus of efforts to improve severe weather detection and avoidance will be on wind shear. The National Research Council Committee on Low-Altitude Wind Shear and its Hazards to Aviation issued its final report and recommendations in 1983. The committee's principal finding confirmed that "low-altitude wind variability (or wind shear) presents an infrequent but highly significant hazard to aircraft landing or taking off."

Since the issuance of that report, the aviation community has made progress toward reducing the hazards associated with wind shear. A great deal of information has been developed concerning the nature of wind shear. It continues to be the object of some of the most dedicated and intense research in meteorology.

ATA airlines have for many years provided flight crews with available information about wind shear and continue to add to that base of knowledge as new information is developed. Although the basic hazards to flight of variable and shifting winds have been known for a long time, it is only in recent years that research has yielded detailed information on phenomena such as downbursts or microbursts.

For example, in-depth meteorological research associated with a landing accident at Kennedy Airport in 1975 brought to light the first accurate understanding of the downburst phenomena, while it was the JAWS, Joint Airport Weather Studies, program at Denver which illuminated important characteristics of microbursts.

Airline training curricula have been modified to include the latest available windshear data, including the best possible information on recognition of the threat, avoidance and flight procedures in the event of an inadvertent wind shear encounter. Let me emphasize here that recognition and avoidance are the focus of airline training programs.

More can be done and if additional funds are necessary they should be provided. It makes no sense to have a huge surplus in the Aviation Trust Fund when known aviation safety needs are not being adequately met by the government. Airline users—passengers and shippers—have every right to expect that the money pay in user taxes—$3 billion a year—will be spent for the purposes for which it was collected.

With regard to wind shear, more can be done to improve its detection and avoidance. The Next Generation Weather Radar, NEXRAD, utilizing Doppler technology, holds forth the promise of much better detection and early warning of severe weather phenomena, including wind shear and its precursors. No effort should be spared to ensure that this program proceeds at the fastest practical pace. Dependant upon NEXRAD, at least under current programming timetables, is a derivative system known as the terminal Doppler weather radar, which we hope will provide crucial weather warnings at the airports where they are most needed. The airlines will continue to work with FAA and its contractors to ensure that operational requirements are fully considered in the development of improved hazardous weather detection and warning systems.

We are troubled that the NEXRAD program has not had consistent full budgetary support. It is vital that this program not be delayed or constrained in any way and to that end ATA will fully support any budgetary request by FAA to ensure that those goals are met. We also support any additional funding needed to accelerate development of the terminal Dopper radar. The money is readily available in the Trust Fund. A final decision to implement terminal Doppler radar should await demonstration of the capability to provide simple and timely wind shear warnings to flight crews. We will then have to watch closely to ensure that funds for the purchase of terminal Doppler radar are not diverted from essential elements of the National Airspace System Plan. That project is pushing a $1 billion funding shortfall that could drown the program if funding deficiencies to-date are not recovered, starting in fiscal year 1987.

Another research program that is worth pursuing is airborne detection equipment—Doppler radar or similar devices that can be used on board every airline aircraft to look ahead and provide improved hazardous weather avoidance detection capability en route and at every airport into which the aircraft flies, regardless of whether that particular airport has a ground-based Doppler weather radar. Such a program should be jointly pursued by NASA and FAA and we have recently advocated action to both agencies.

Turning again to wind shear training for airline flight crews, we have already noted that this training has been continually improved over the last several years as new information about wind shear developed. The next appropriate step in the training area is to bring all of the available information resources together to develop a model training package or training aid. As a result of ongoing discussions between the aircraft manufacturers and ATA member airlines, Boeing, United Air Lines, Douglas Aircraft Co., Lockheed, and Aviation Weather Associates have submitted an unsolicited proposal to FAA to develolp just such a program—something that could be considered an authoritative training aid and that would be made available to all airlines—as well as other operators of similar aircraft—who could then tailor it to their own operational and training needs. We expect that such a training aid could be available within about 18 months after go-ahead.

Wind sheer training—the principal lesson of which is recognition and avoidance—will continue to receive high priority because flight crews will always need to know how to evaluate whatever wind shear information they are provided and must be trained to survive inadvertent encounters with hazardous conditions. As the body of knowledge concerning wind shear continues to grow and improve, the training of flight crews will be enhanced.

I would suggest to this committee that because the pilot in command is the final judge and authority in the cockpit of any airplane, wind shear training must be an integral part of the training program for all airlines operating large jet aircraft. As in other areas, each airline is responsible for developing its own training program and getting it approved by FAA. The authoritative training aid that I described earlier could provide an important information base from which an appropriate training program could be developed.

AIR TRAFFIC CONTROL

The U.S. air traffic control system is safe. It is not, however, being staffed to efficiently handle the growth expected in air transportation in the very near term. The ATC system has maintained its safety margins since the illegal controller strike of 1981 by slowing down traffic and limiting access to the system. Those techniques continue to be employed as necessary, but probably would not be necessary as frequently if the controller work force were larger and more experienced. The experience level will come with time and with increased emphasis on using all available resources to help meet on-the-job training requirements, such as the increased use of retired annuitants. The size of the work force can and should be increased.

We have recommended in the past that the FAA Administrator be given the flexibility to hire additional controllers. We would like to take this opportunity to commend Secretary Dole and Administrator Engen for announcing decisive action to strengthen the air traffic control system by the addition of nearly 1,000 controllers over the next two fiscal years.

The augmentation of the ATC system announced by DOT is an important step in helping to assure that the nation's aviation needs in the years immediately ahead will be met safety and efficiently. The anticipated addition of controllers reflects the record growth of air transportation. In her statement September 19, Secretary Dole noted this, saying, "The Department's essential task now is to ensure that the controller work force is maintained at a high level that will be fully responsive to present challenges: an industry flourishing in the freedom afforded by deregulation; increasing use by airlines of "hub-and-spoke" operating patterns; and passenger demand that is expanding on the strength of economic recovery."

In other areas of air traffic control, much interest has been expressed in TCAS, the threat alert and collision avoidance system under development by FAA. Unfortunately, that program has a number of technical hurdles to be cleared before it is ready for use in airliner cockpits. In the meantime, a meaningful safety enhancement could be realized through the carriage of altitude-encoding transponders by a significant percentage of the aircraft population operating in busy terminal airspace. Increased carriage and use of this equipment would improve air traffic surveillance in these busy areas.

FAA INSPECTION AND SURVEILLANCE

ATA member airlines are aware of their legal and moral responsibility to uphold the highest standards of maintenance and operational safety.

The FAA is charged with monitoring airlines and other aviation elements to ensure that those safety responsibilities are in fact carried out. It is in the interests of both the public and air carriers for FAA to have the necessary resources for its inspection and surveillance activities. We are not aware of deficiencies in FAA inspection and surveillance procedures of ATA carriers. However, we want to cooperate in every way with FAA in its inspection responsibilities and if more inspectors are needed they should be hired.

We believe that DOT's recently announced intention to increase the number of inspectors recognizes the increase in the number of new airlines and aviation activities. If FAA requests more inspectors, such a request will have our support.

Senator KASSEBAUM. Thank you. Captain McNair.

Mr. MCNAIR. Good afternoon Madam Chairman and members of the subcommittee. I am Capt. Louis M. McNair, executive central air safety chairman of the Air Line Pilots Association.

I am testifying today on behalf of over 34,000 ALPA members who fly for 49 airlines. We commend the subcommittee for its ongoing concern about the safety of the system in which we operate. We have submitted for the record a detailed text of our testimony dealing with the three topics of interest to the subcommittee, namely wind shear, the air traffic control environment, and the FAA's inspection program.

We appreciate the opportunity to appear before you today and present a brief summary on the air traffic control environment. During the past 3 years, ALPA has testified on several occasions before various congressional committees on the adequacy and safety of the air traffic control system during the rebuilding process since the PATCO strike of 1981.

On June 16, 1983, we presented our views on the National Transportation Safety Board's followup study of the U.S. air traffic control system. In that report, the Board stated in part that the existing margin of safety has to be determined by means of investigation of incidents or other indicators of potential accidents.

The Board at that time concluded that such a determination was difficult because of a definite trend of unreported incidents of all types. ALPA agreed with that conclusion, and we believe that a large number of near miss situations were, in fact, not reported. However, we do believe that the FAA has been sincere in its efforts to collect data on incidents which occur in our ATC system by implementing a Quality Assurance Program designed to detect operational incidents involving loss of separation between aircraft.

Unfortunately, this program appears to be taking on the same character as the Near Midair Collision Reporting Program, in that there does not appear to be any one office in the FAA responsible for a comprehensive, safety-oriented analysis of the data obtained from the program. We believe that this is a serious management deficiency and that the agency must have a consolidated program which ensures: One, the reliable reporting of all incidents; two, one central office to analyze the incidents; and three, the ability to develop prompt corrective action.

The total number and scope of incidents in the air traffic system being reported and investigated has increased dramatically. There may have been over 2,000 operational errors, pilot deviations, and near misses in 1984. There were approximately 400 near midair collisions in 1983, and 300 the year before.

The FAA is publicly releasing statistics on near misses only when they have been formally reported. On August 28 of this year the FAA acknowledged that the number of near midair collisions for the first 7 months of 1985 is 439, a 40-percent increase over the same period in 1984. We find no consolation in any statements which rationalize the ratio of near midair collisions to the number of flights flown as Administrator Engen has done in an August news release.

The fact remains that every near miss or operational error is a potential catastrophe. That is why ALPA, recognizing that the U.S. air traffic control system is and probably never will be able to provide separation to all aircraft, continues to press for the expeditious development and implementation of an effective traffic alert and collision avoidance system, or TCAS.

We feel that the development of an effective airborne collision avoidance system is long overdue and that the FAA should increase its emphasis on the TCAS 3 system. In our opinion, the TCAS 2, which provides only vertical escape maneuvers, is inadequate for airline needs.

Since the PATCO strike of 1981, there have been numerous studies made of the ATC system to determine the underlying reasons for the strike, assess the morale of controllers, and monitor the process of rebuilding the ATC system. The most recent of these is the report by the Subcommittee on Investigations and Oversight of the House Public Works and Transportation Committee, which concluded that serious problems continue to exist in the air traffic control system.

Certainly, no one can fault the dedication and professionalism displayed by the air traffic controllers of the Federal Aviation Administration who have continued to provide a safe transportation system since the strike. What they have done is almost incredible, and the challenge they face for the next few years will continue to be demanding. They are working long hours in an intense training environment using outdated equipment, having little direct supervision and facing the possibility of steadily building traffic.

Equally demanding are the managerial tasks faced by the FAA managers to improve human relations within the system. The subcommittee's report highlights the fact that from a human factors point of view the system seems to be in the same posture it was 4 years ago. The subcommittee found that controllers continue to be overworked, overstressed, and complain of continued bad management at the middle level management level of the FAA.

We have been reviewed and agree with the recommendations contained in the report, particularly those dealing with controllers staffing and traffic handling. We believe it is important that the entire aviation community, including the FAA, accept the conclusions of the subcommittee's report that serious problems continue to exist within the ATC system.

We would further urge that progressive steps be taken to improve the overall situation rather than have such actions dictated as a result of catastrophic accidents.

Everyone in the industry agrees that action must be taken to maintain safety in the skies. There is no other acceptable alternative, but there are two options about how to do this. We can reduce through quotas and flow control and other artificial constraints the number of aircraft in the sky, or we can work to increase the capacity of the system.

Frankly, with the economic recovery of the Nation and with the airlines poised to recoup terrific losses from the postderegulation period, it would be a cruel blow to the traveling public and the airlines to arbitrarily reimpose vast restrictions. Instead, we must focus all our collective energies into making the system grow, while at the same time insuring no degradation of the margin of safety.

We are aware of Secretary Dole's announcement to phase in about 960 controllers over the next 2 fiscal years. This is a step in the right direction. Prior to the strike there were over 13,000 fully qualified controllers, and today that figure is approximately 8,000. While the total controller work force numbers 14,300, in our opinion this obviously increases the margin for error due to a lower level of controller experience and therefore reduces the level of safety overall.

Hiring more people does not necessarily increase the number of qualified controllers. We recommend that the FAA, through prudent and effective use of flow control, continue to limit the amount of air traffic that is allowed into the system until the required number of qualified and experienced controllers are available to staff all control positions adequately.

In this regard, we urge that you and your colleagues support the necessary funding of the FAA program for improving the air traffic control system. It is easy to cite weaknesses in the system but more effective to offer solutions, and we have offered to the FAA recommendations for making a good air traffic control system even better. Copies of these recommendations are provided for the record as an attachment to our submission.

The recommendations were all directed to the goal of maintaining or improving the safety of the system. The FAA has taken actions on some of our recommendations. For example, notices of proposed rulemaking have been issued to: One, require all aircraft carrying transponders to turn them on in flight; two, require that all aircraft operating above 10,000 be equipped with altitude encoding transponders; three, raise the top of all existing terminal control areas to 10,000 feet mean sea level; four, expedite the designation of airport radar service areas.

But all these require regulatory action which historically is a slow process. Several other recommendations which we have provided are still under review, and no action has been taken. We believe all of our recommendations are directed toward enhancing the ATC system and that most can be implemented with minimum economic impact on the users. Our goal, like yours, is to increase the safety of the air traffic system.

Thank you, Madam Chairman, and I will be ready to respond to questions.

[The statement follows:]

Statement of Capt. Louis M. McNair, Executive Central Air Safety Chairman, Air Line Pilots Association

Madam Chairman and members of the subcommittee, I am Captain Louis M. McNair, Executive Central Air Safety Chairman of the Air Line Pilots Association. I am testifying today on behalf of the 34,000 ALPA members who fly for 49 airlines. We commend the subcommittee for its ongoing concern about the safety of the system in which we operate.

Our statement consists of three subject areas, and each is dealt with separately in three attachments. The three areas are: windshear, the air traffic control environment, and the FAA's inspection program.

WINDSHEAR

As pilots, severe weather and, in this particular instance, windshear are of great concern to those of us who are confronted with its direct effects in the performance of our duties. We take professional pride in the knowledge that we are sufficiently trained and capable enough to master difficult situations that might confront us. However, in the case of severe weather, or professionalism demands a healthy respect for the dangers that such phenomena hold for the aircraft we fly and the passengers we carry. One such phenomenon is windshear, whose most severe form, a microburst, is often beyond the capabilities of the most proficient pilot.

I'm sure you are aware that a great deal has already been said about severe weather and its effects on aviation. I am confident that even a cursory review of congressional files would find them replete with testimony that pointed out the same problems and proposed the same solutions that you will hear today. It appears that what is needed most is a sense of priority and immediate, aggressive action by the Federal Aviation Administration, the National Weather Service, and even the Congress.

Having said that, we want to express our appreciation for this opportunity to share some of our thoughts with you today and would like to make the following comments.

Much has been said about the next generation radar technology (NEXRAD) and its application not only to detecting general, large weather patterns, but also its application to aviation weather. The justifiction for this system is well documented, needs little if any embellishment, and is certainly able to withstand any challenge. The current long-range weather detection system is archaic from both an operational and maintenance standpoint, and for years has not met the requirements of users for adequate weather information. The technologies incorporated into this NEXRAD system, such as Doppler radar, represent a quantum leap in our capabilities. This program will put into the field a technological base that can be expanded and refined as we become more and more adept at its use. We are not aware of any other type of equipment that would provide a level of service comparable to that of NEXRAD, and we firmly believe the only legitimate question is why it has taken so long to put the operational systems into service. The NEXRAD program has recently been unnecessarily delayed by OMB, and the entire severe weather detection program lacks emphasis and direction. We urge you to throw your full support behind this most important program.

With all its promise, NEXRAD fulfills only part of the urgent needs of the aviation user. It will certainly be able to generate excellent weather information for enroute planning, but if we hope to use this technology to detect windshears and microbursts, it must also be able to perform in a terminal airport environment where these phenomena are the most dangerous to aircraft. Because of such issues as siting, resolution, and processing time, the only practical application of this technology for this purpose is the Terminal Doppler Weather Radar System. As a necessary adjunct to and extension of the NEXRAD program, we strongly support such a system. It is the most direct way to best apply the NEXRAD technologies to the problem of severe weather in an airport environment. At its current level of development, however, we are not yet convinced that the Doppler technique, when applied to the dynamic requirements of terminal airport operations, will provide the consistency necessary to solve the issue of windshear detection. We consequently endorse an intense research program and further development of application techniques focused on determining if such a product can reliably and consistently detect the types of windshear that have been responsible for a number of tragic accidents. Further, we ask that concurrent funding be made available for an equally aggressive research, development, and evaluation of an airborne sensor capable of reliably detecting the various forms of windshear and other severe weather in the immediate vicinity ahead of an aircraft. This would provide the pilot with state-of-the-art weather detection wherever he flies, would not limit the application of such technologies to a select number of airports within our national airspace system, and would provide the aviation public with the maximum degree of protection from future tragedies such as Delta 191 in Dallas. Many promising studies are currently underway of airborne sensors such as infrared sensors, laser-Doppler techniques, and airborne Dopplers. These activities must be continued.

We have talked mostly about the more direct, technical solutions to the problems of severe weather and windshear. It is important to realize, however, that we still are unclear about the full nature of severe windshears and, in particular, microbursts. If we are to have any success in mitigating this problem, continued research in this area must be funded and carried out. It is one thing to be able to detect these phenomena; another to understand, perdict and combat them.

It is easy enough to say simply that avoidance is the best solution, but until we develop a fail-safe detection system, we must educate the system user, whether pilot or controller, to the nature of the phenomenon and how best to deal with it once he finds himself confronted by it. I cannot emphasize enough, Mr. Chairman, that all the technology in the world will not solve this problem if we do not supplement it with adequate training and informaton to the user. Such training should first and foremost separate the microburst from other forms of windshear. Calling a microburst "windshear" is like calling a tornado "gusty winds." When strong windshears are detected that are associated with convective cell activity, they should be reported as "microbursts." Aviation users should be made aware that microbursts are phenomena that even if detected cannot be flown through successfully and must be avoided at all costs. Contrary to many stories in the press and letter to editors in aviation journals decrying the dangers of flying through thunderstorms and pronouncing the wisdom of these authors who don't, the fact is that no pilot willingly files through a thunderstorm. The Air Line Pilots Association fought long and hard for the requirement for airborne weather radar which has proven its worth in allowing pilots to avoid thunderstorms. The problem is that in the summer there are thousands of rain showers that are not associated with microbursts, and it is impractical to cease flight operations every time it rains just as it is impractical to advise people to go to storm cellars when it rains to protect against possible tornados.

It should be noted that strong microbursts can occur from convenctive cells that are not technically thunderstorms. This is especially true of microbursts in high, dry climates such as measured in Denver by the JAWS project. It now appears, though, that the strongest microbursts by far are the wet ones which occur from rapidly building new cells. The strongest microbursts measured by the JAWS project have been on the order of 95 knots peak to peak with the maximum wind in one direction being about 60 knots. However, the microburst documented by Dr. Fujita which occurred at Andrews Air Force Base on August 1, 1983, measured a peak wind in one direction greater than 130 knots. This is consistent with damage patterns observed on the ground when large trees are either uprotted or have their tops torn off by microburst winds.

In a headlong rush to develop flying techniques for successful escapes from windshear, much misinformation has been disseminated. This is due largely to the fact that we still do not understand the dynamics of a microburst itself, much less its effects on air aircraft. Dr. Fernando Garacena, an atmospheric physicist for NOAA and a pioneer in the identification of the microburst problem related to aircraft, has hypothesized that a rapidly building new storm cell carries a large amount of moisture to levels much higher than can be substained. This is like throwing a ball up. When the moisture comes down, it does so with tremendous energy. This event is probably responsible for the collapsing top of certain convective cells as observed by Dr. Fujita a number of years ago. Apparently a particularly dangerous convective cells is the new cell that is being fed by mature thunderstorms which are nearby. The outflow of cold air from the mature cells combines with hot surface air to generate a new and very rapidly building cell. As moisture is carried aloft to fire the first microburst, pilots of aircraft at low altitude and close to the cell will not detect the high level of moisture at the top because of the limits of radar antenna tilt. Pilots will first see this cell on radar as a rain shower, and consequently be unaware of the imminent danger involved. Much more research in this area must be accomplished before we can be confident in our responses to microbursts.

In the past pilots have been accused of inappropriate flying techniques during windshear accidents because, in their limited expertise with windshear, investigators have not realized the severity of the performance degradation and have incorrectly surmized that the pilot could have flown out of the encounter. ALPA first began to be concerned about windshear incidents when defending pilots accused of careless and reckless operation in just such incidents. In an early windshear incident at Austin, Texas, the FAA asked for the suspension of the pilot's license for nine months. The valuable lessons that could have been learned from this incident were not recognized until the loss of the Iberia DC-10 at Boston in 1973, in an almost identical situation.

Similarly, pilots who hit trees and power lines in the approach path were accused of pilot error. Valuable information to prevent other pilots from being caught in similar conditions was not developed. With all of the incidents and accidents being written off as pilot error, pilots were not prepared for the type of encounters that were possible. Their biggest error was in believing the conclusion of the accident reports. As time progressed, the reports simply concluded with statements that if the pilot has used all of the performance available to him he could still have flown out of the situation. With such conclusions, it should be no surprise that many pilots still believe they can fly out of microbursts.

Many analysts have understated the magnitudes of the microbursts by making unreasonable assumptions in their analysis. They have assumed instantaneous windshears. They have designed windshear models for simulators to prove their opinions of aircraft performance and have told pilots to fly aircraft in a stall-like condition when well above the ground to prevent a descent when a descent is inevitable. They have suggested that the pilot use a predetermined pitch attitude even when such an attitude would be impossible in strong encounters. They have neglected clear evidence of microburst escapes that saved aircraft and instead have attributed the saves to some assumed actions by the pilots.

Figure 1 is a portion of the flight data recorder (FDR) from National Airlines Flight 32 at New Orleans on July 26, 1972. The aircraft made an approach to Runway 28 beneath a thunderstorm and hit trees in the approach path. Notice the reduction in airspeed and high descent rate, (a), which is followed by a very rapid increase in airspeed, (b), as the aircraft flew out of the trees. This rapid increase in airspeed is indicative of penetrating the boundary of the microburst and is the only reason the aircraft didn't crash.

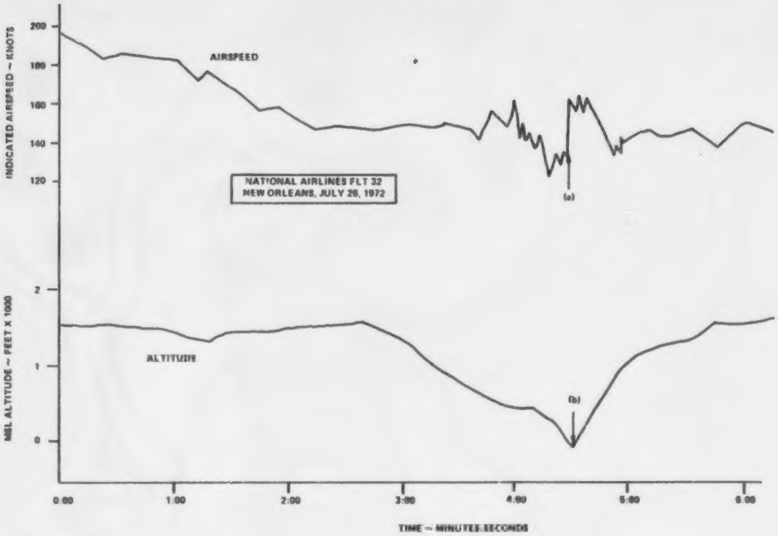


FIGURE 1

Figure 2 shows a similar increase in airspeed in the takeoff case of Continental Airlines Flight 63 at Tucson on June 3, 1977. The aircraft hit a power line immediately after takeoff, (a). It was immediately after that point that the airspeed increased 27 knots in one second, (b), which is what saved the aircraft. The Board report says, however, that the pilot lowered the pitch of the aircraft to increase airspeed and that is what cause the aircraft to hit the power line.

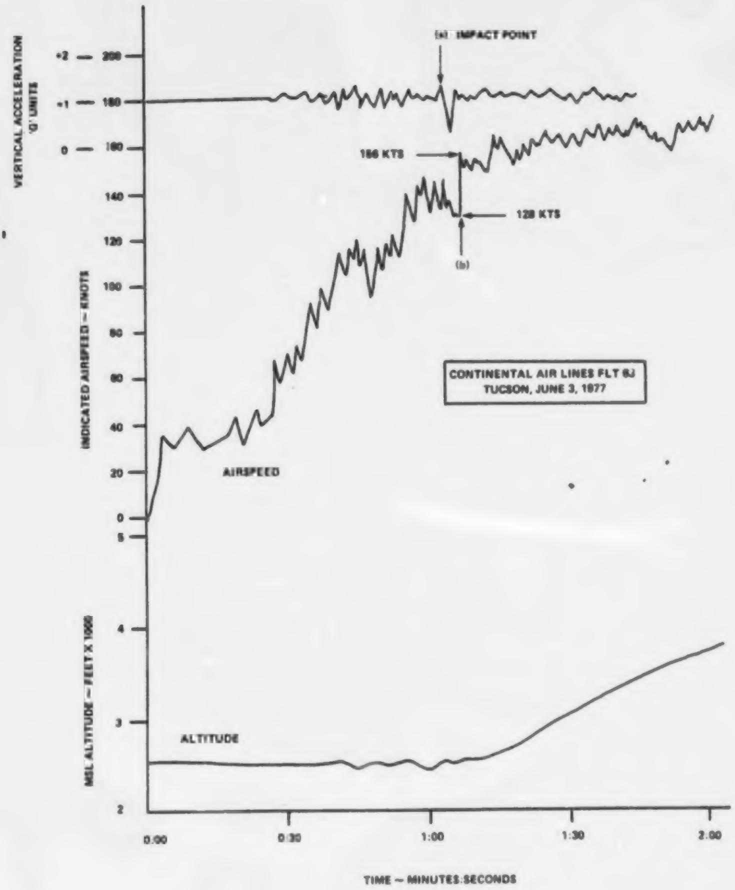

(a) IMPACT POINT
VERTICAL ACCELERATION 'G' UNITS
+2
+1
0
INDICATED AIRSPEED ~ KNOTS
200
180
160
140
120
100
80
60
40
20
0
156 KTS
128 KTS
(b)
CONTINENTAL AIR LINES FLT 63
TUCSON, JUNE 3, 1977
AIRSPEED
MSL ALTITUDE ~ FEET X 1000
5
4
3
2
ALTITUDE
0:00
0:30
1:00
1:30
2:00
TIME ~ MINUTES:SECONDS

FIGURE 2

Figure 3 is the FDR from Eastern Airlines Flight 693 at Atlanta on August 22, 1979. Here again is a rapid descent, (a), which is followed by the rapid airspeed gain, (b), that caused the aircraft not to crash (there is probably a small error in correlation between the airspeed and altitude traces). The pilots in that case overboosted three engines to the point they had to be replaced. At our last appearance before this committee the FAA claimed credit for pilot training as having saved that aircraft as the pilots were presumed to have flown the aircraft on the stick shaker to get out of the microburst. It is clear from examination of the airspeed trace that the pilots did not immediately fly to the stick shaker to prevent a descent as some have recommended. If they had done so, they would probably never have recovered from the resulting stall-like condition. They did, however, allow the airspeed to gradually decrease as they got closer to the ground, a normal reaction for a pilot.

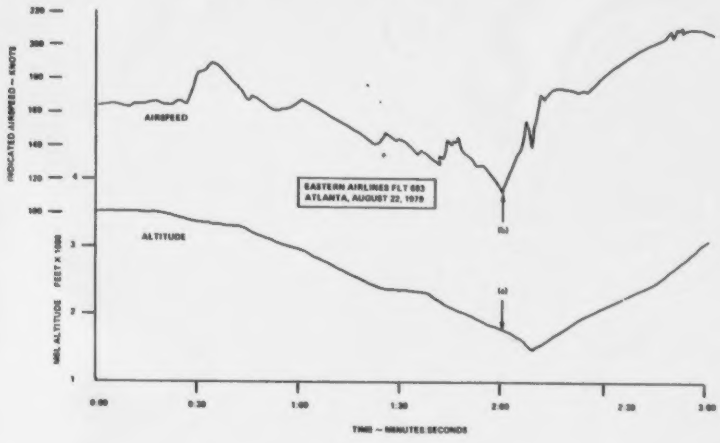


FIGURE 3

Figure 4 is the FDR trace from United Airlines Flight 663 at Denver on May 31, 1984. Here again is the airspeed spike, (a), which occurs as the aircraft hit the ILS antenna, (b), only a few feet above the ground. Although training and cockpit resource management may have played a part in surviving this microburst encounter, it should be clear that had the aircraft not penetrated the boundary of the microburst when it did, the result would have been significantly different.

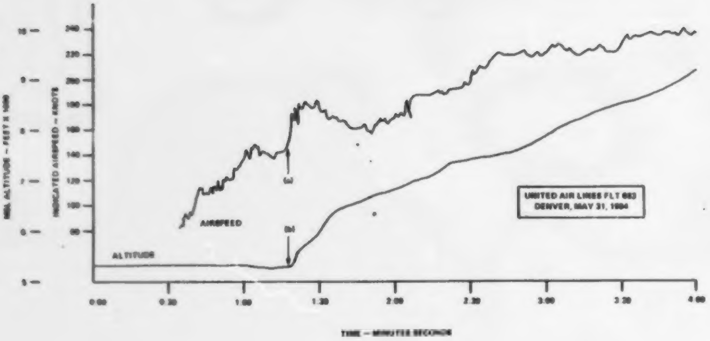


FIGURE 4

It is apparent from the examination of the FDRs of the two aircraft which had departed just before UAL 663, UAL Flights 415 and 757 (Figure 5), that they had both experienced the airspeed spike characteristic of penetrating a microburst boundary. Both of these flights were apparently still on the runway when they went through the microburst. An instrument on the aircraft which could have identified these spikes as windshear would have told these flight crews that they had penetrated a significant windshear and their reports could have prevented UAL Flight 663 from taking off.

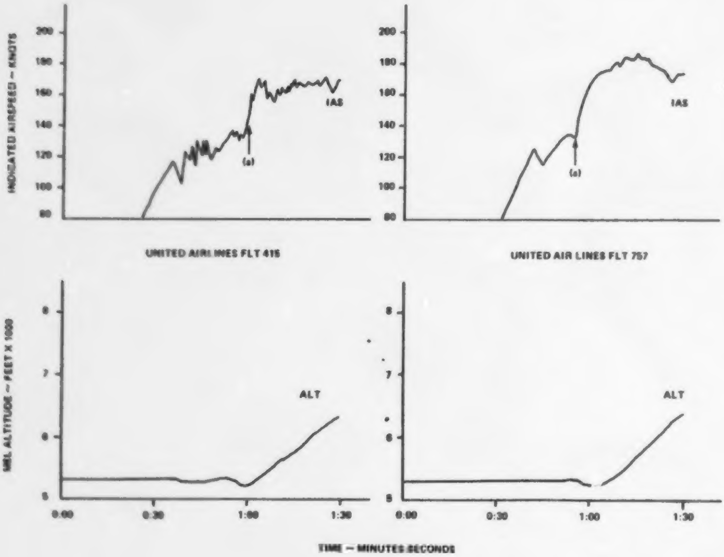
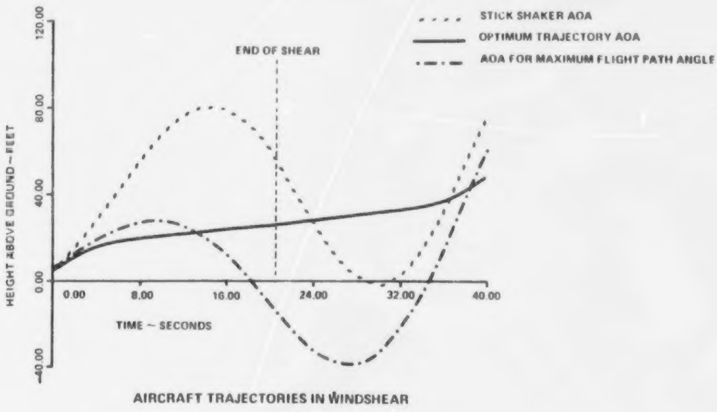


FIGURE 5

In the many suggestions of how pilots should have flown out of microbursts, there has been lacking a basic understanding of what the optimal trajectory of a particular aircraft in a particular windshear would have been. Basic research into the solution of optimum trajectories must be completed before answering the questions of best piloting inputs or whether new or improved instrumentation would enhance piloting.

Dr. Angelo Miele, an eminent authority on the subject of optimal trajectories problem. AIAA Report No. 85-1843-CP gives the first results of the Nasa-funded study. Figure 6 is taken from the report and shows the altitude versus time profiles of an optimum trajectory and two trajectories flown at a constant angle of attack, one at the best angle of attack for maximum flight path angle in still air and the other where the aircraft has been deliberately flown at an angle of attack corresponding to the stick shaker. It is clear that neither of the constant angle of attack trajectories should be considered satisfactory. Note that the windshear ends at approximately 20 seconds and at that time the stick shaker technique appears to do quite well. However, a pilot can not prevent the resultant oscillation if he stays at the stick shaker. In the optimal trajectories, the angle of attack is gradually increased (but not to the stick shaker) and the airspeed is gradually decreased in a manner similar to the way a pilot flares an aircraft from a high descent. After understanding the optimal trajectories, it may be possible to devise the best strategies for pilots based upon present instrumentation and determine requirements for new instruments to aid pilots. Much more important work needs to be done in this area, and we ask that this effort receive your full support.



AIRCRAFT TRAJECTORIES IN WINDSHEAR

FIGURE 6

Mr. Chairman, another integral part of any solution to this problem is an area that has been addressed many times before and still desperately needs attention. That is the need for an effective weather information dissemination system. I think you will find that in most weather-caused aircraft accidents someone in the system knew about the severe weather that caused the accident, but the pilot involved in the accident never received the information. This unfortunately is the rule rather than the exception. When confronted with the problem of weather information dissemination, the FAA response is usually one of creating another research and development program rather than conceiving innovative means of effectively using available resources.

An NTSB recommendation of April 1976 urged that the FAA "develop and institute procedures whereby approach controllers, tower controllers, and pilots are provided timely information regarding the existence of thunderstorm activity near to departure and approach flight paths." This recommendation was closed on December 18, 1984, with the notation of "acceptable action." This is difficult to understand since the accident report of USAir Flight 183 at Detroit on June 13, 1984, doucments the fact that the National Weather Service observation of ". . . visibility 1/4 mile in thunderstorm with heavy rainshowers and hail . . ." was being prepared six minutes before the crash but did not get transmitted to the tower until about the time of the crash. The weather observer during the time of this accident described the thunderstorm as a "very localized storm" with rapid development that was "almost explosive." This description fits the hypotheses of Drs. Fujita and Caracena mentioned earlier. This highly time-critical information should have been immediately transmitted to the tower for use in local control. FAA responses to the NTSB recommendation stated an intent to use National Weather Service radar information for the terminal area, but this has apparently not been implemented.

The NTSB also neglected to make a recommendation on the timely transfer of information to the pilots inolved in this Detroit accident. Instead, they again emphasized only the human factor, deemed the incident survivable, and blamed it on pilot error. At the same time they have taken credit for their recommendations concerning present training, especially cockpit resource management, while ignoring the single most important factor in successful penetration of a microbust, the instantaneous airspeed increase upon exiting the microburst. ALPA strongly supports cockpit resource management training, but in must be clearly understood that this training does not deal with specific aircraft operations. Cockpit resource management is a method of sensitizing pilots to useful management techniques and interactions between crew members. It is distressing that the NTSB and the FAA still have not learned enough from past incidents to deal more objectively with such occurrences.

As I have said earlier. the present weather radar system is quite old and limited in its performance. However, the industry has also been guilty of underutilizing its capabilities and is inefficient in disseminating the information it provides. Surface weather radar such as used by the National Weather Service (NWS) is capable of assessing situations conducive to windshear but is not used to provide information on hazardous weather in airport terminal areas. There have been numerous accidents after which it became evident that NWS radar had detected a significant thunderstorm directly over the approach or departure path of the aircraft before the accident. In 1983 the National Academy of Sciences undertook a study of windshear and one of its concluding recommendations was that "the existing network of weather radars, operated by the National Weather Service, should be used more effectively to judge the likelihood of windshear conditions." The report went on to say that, used properly, these radars could aid in the detection of windshear and that this information "should be made available to air traffic controllers in a timely and easily understandable fashion." This timely dissemination of information about severe windshear and microbursts in a terinal environment is of immediate concern. Even with Doppler techniques such detection is possible only after a microburst has developed, and the span of only a few minutes can mean the difference between avoidance and tragedy.

Besides its timely dissemination, such information should also be useful and appropriate to the severity of sick phenomena. Currently there are varying interpretations and terminologies used to describe windshears and their relative effects on aircraft performance. In congressional testimony before the Committee on Science and Technology in 1982, ALPA recommended the implementation of a system of windshear alterts. This system would be standarized, would be based on local windshear development, and would draw a distinction between windshear and microburst. We still support such an endeavor.

Finally, Mr. Chairman, because I am pragmatic I understand that even with your full support we pilots will have to make the best of our present system for several more years until such technologies as we have discussed become operational. We can only emphasize to you that in the interim there is much that can be done to improve the present system and there is a great deal of legitimate, promising research that needs your support. Of primary concern is the improvement of weather dissemination. Air safety would be increased if the information we are able to obtain today would be received by the users more quickly. Likewise the systems in use today to detect windshear, such as the low level windshear alterting system (LLWAS), could and should be improved. Many recommendations have been documented for improving LLWAS, such as increased sensor arrays, new detection algorithms, and data recorders. Until such improvements are incorporated, LLWAS will be of limited value and a questionable investment as a solution to the windshear problem.

In closing, I must say that I feel some frustration as I present this testimony. Although grateful for the chance to speak before you today, I am reminded that we and many other groups have voiced these same conerns before. In response to previous testimony and as recently as September 1983, the National Research Council undertook and in-depth analysis of the problem of low altitude windshear and its danger to aviation. The 19 recommendations that were developed out of that study cover the same issues we have presented here. To this day the FAA has taken action on only 6 of those recommendations. It is a shame that such issues as these only receive their rightful emphasis when tragedies such as Delta 191 befall us. Let us hope that this time we have the strength of will to follow through with necessary action.

THE AIR TRAFFIC CONTROL ENVIRONMENT

During the past three years, ALPA has testified on several occasions before various congressional committees on the adequacy and safety of the air traffic control system during the rebuilding process since the PATCO strike of 1981. On June 16, 1983, we presented our views on the National Transportation Safety Board's "Follow-up Study of the United States Air Traffic Control System." In that report the Board stated, in part, that "the existing margin of safety has to be determined by means of investigation of incidents or other indicators of potential accidents." The Board, at that time, concluded that such a determination was difficult because of a definite trend of unreported incidents of all types. ALPA agreed with that conclusion, and we believed that a large number of near-miss situations were, in fact, not reported.

However, we do believe that FAA has been sincere in its efforts to collect data on incidents which occur in our ATC system by implementing a Quality Assurance Program designed to detect operational incidents involving loss of separation between aircraft. Unfortunately, this program appears to be taking on the same character as the near mid-air collision (NMAC) reporting program in that there does not appear to be any one office in the FAA responsible for a comprehensive, safety-oriented analysis of data obtained from the program. We believe this is a serious management deficiency. However, the important point we wish to make is that the FAA should uniformly collect data on all incidents, and that the agency must have a consolidated program which ensures: (1) reliable reporting of all "incidents," which must include coordination with the military services to ensure incidents involving civil aircraft that are reported within their channels are considered, not just NMAC's; (2)a centralized source for analyzing the incidents to determine deficiencies, trends, etc., and (3) the ability to develop prompt corrective action. The data should be shared with the aviation community so we can have some idea of what problems exist in the ATC system.

If it is determined that the FAA cannot or is unwilling to develop such a system, then all data should be turned over to the ASRS program as suggested in the National Transportation Safety Board Recommendation A83-40. This recommendation was intended to improve compliance with existing FAA directives and provide guidance to air traffic controllers and staff on the use of FAA-sponsored NASA Aviation Safety Reporting System to supplement existing incident reporting programs.

We also have to recognize that the total number and scope of incidents being reported and investigated has increased dramatically. There may have been over 2,000 operational errors, pilot deviations, and near-misses in 1984. There were approximately 400 near mid-air collisions in 1983 and 300 the year before. FAA is publicly releasing statistics on only formally reported near-misses. On August 28 of this year, the FAA acknowledged that the number of near mid-air collisions for the first seven months of 1985 is 439, a 40% increases over the same period in 1984. We find no consolation in any statements which rationalize the ratio of NMAC's to the number of flights flown, as Administrator Engen has done in an August news release. The fact remains that every near-miss or operational error is a potential catastrophy. That is why ALPA (recognizing that the U.S. Air Traffic Control System is not and probably never will be able to provide separation to all aircraft) continues to press for the expeditious development and implementation of an effective Traffic Alert and Collision Avoidance System (TCAS). We feel that the development of an effective airborne collision avoidance system is long overdue. While TCAS I and TCAS II offer many advantages over earlier designs in terms of ground system independence, and cost, they are not suitable for airline operations. The development of TCAS II is currently stymied within the FAA. The Phase II tests at Piedmont Airlines and the Limited Implementation Program (LIP) for TCAS II have been delayed by FAA certification personnel who are apparently concerned about the limitations of the TCAS II System. These limitations include vertical-only escape maneuvers, poor directional antenna accuracy, and limited operation capability in dense traffic areas, such as Los Angeles. The vertical-only escape maneuvers restrict the use of the system, especially for flights at high and low altitudes where aircraft performance is the limiting factor. For example, at high altitudes, the vertical-only escape maneuver may require the aircraft to descence through the altitude of another aircraft, which is contrary to the pilot's natural instinct. In this instance, the pilot would be reluctant to follow the descend command. This reluctance would cause a delay in the pilot's reaction time, thereby jeopardizing the validity of the TCAS logic which is based on a 1500-feet-per-minute rate of descent with 8 seconds for pilot/aircraft reaction. This problem was confirmed in an FAA flight test in their B727 of the TCAS II system in February, 1985.

In contrast to these restrictions, TCAS III offers more accurate information, both horizontal and vertical escape maneuvers, and a reduction in unnecessary alarms. Clearly this system is much more appropriate for airline installation primarly because of the increased accuracy and the addition of a horizontal escape maneuver which could prevent a collision at both high and low altitudes. TCAS III has also been flown aboard the FAA's B727 aircraft in early 1985, and the test results prove conclusively that there was no system degradation in high traffic density environments. A Bendix report has been given to the FAA on those flight tests and the FAA is in the process of reviewing the flight data for those tests. Also, as reported in an article by Philip J. Klass, in the May 20, 1985 issue of Aviation Week magazine, the cost of the TCAS III may not exceed that of TCAS II by more than 20%. Mr. Klass' article went on to describe accurately the improved operational benefits provided by TCAS III. For these reasons we fell that the FAA should increase its emphasis on the TCAS III system. Unfortunately, it does not appear there are any future FAA plans for the development of this superior system.

Since the PATCO strike of 1981, there have been numerous studies made of the ATC system to determine the underlying reasons for the strike, to assess the morale of controllers, and to monitor the process of rebuilding the ATC system. The most recent of these is the report by the Subcommittee on Investigations and Oversight of the House Public Works and Transportation Committee which was released on September 10. This report concluded that "serious problems continue to exist in the air traffic control system." Certainly no one can fault the dedication and professionalism displayed by the air traffic controllers of the Federal Aviation Administration who have continued to provide a safe transportation system since the strike. What they have done is almost incredible, and the challenge they face for the next few years will continue to be demanding. They are working long hours in an intense training environment, using outdated equipment, having little direct supervision, and facing the possibility of steadily building traffic. Equally demanding are the managerial tasks faced by the FAA managers to improve human relations within the system. The subcommittee's report highlights the fact that, from a human factors point of view, the system seems to be in the same posture it was four years ago. The subcommittee found that "controllers continue to be overworked, overstressed and complain of continued bad management at the middle management level of the FAA." We have reviewed and agree with the recommendations contained in the report, particularly those dealing with controller staffing and traffic handling. We believe it is important that the entire aviation community, including the FAA, accept the conclusions of the subcommittee's report that "serious problems continue to exist within the ATC system." We would further urge that progressive steps be taken to improve the overall situation rather than have such actions dictated as a result of catastrophic accidents.

Everyone in the industry agrees that action must be taken to maintain safety in the skies; there is no other acceptable alternative. But there are two options about how to do this. We can reduce—through quotas and flow control and other artifical constraints—the number of aircraft in the sky we can work to increase the capacity of the system. Frankly, with the economic recovery of the nation and with the airlines poised to recoup terrific losses from the post-deregulation period, it would be a cruel blow to the traveling public and the airlines to arbitrarily re-impose past restrictions. Instead, we must focus all our collective energies into making the system grow while at the same time ensuring no degradation of the margin of safety. We are aware of Secretary Dole's announcment to "phase in about 960 controllers" over the next two fiscal years. This is a step in the right direction, but it may be too little, too late. Prior to the strike, we understand there were over 13,000 fully qualified controllers in the work force. Today that figure is only about 8,000, while the total controller work force numbers 14,300. To put it another way, the system has some 5,000 fewer fully qualified controllers than before the strike and the experience level is lower. This is our main concern because, in our opinion, this obviously increases the margin for error and reduces the level of safety. Hiring more people does not necessarily increase the number of qualified controllers.

We recommend that the FAA, through the prudent and effective use of flow control, continue to limit the amount of air traffic that is allowed into the system until the required number of qualified and experienced controllers are available to staff all control positions adequately. In this regard, we urge that you and your colleagues support the necessary funding of the FAA program for improving the air traffic control system.

Our greatest concern is the continuing and growing demand to handle more and more aircraft by a relatively inexperienced controller work force. The increasing number of aircraft operating in the ATC system and the rapidly increasing number of operational errors which have occurred in the system lead us to conclude that some procedural and regulatory changes must be made if we are to retain an acceptable margin of safety. It is easy to point to all the problems and to criticize inaction, but it is more effective to offer solutions. We have offered to the FAA several recommendations for making a good air traffic control system even better. Copies of these recommendations are provided as an attachment to our submission. These recommendations are all directed to the goal of maintaining or improving the safety of the system. In response to our recommendations, the FAA has issued a Notice of Proposed Rulemaking to:

1. Require all aircraft carrying transponders to turn them on in flight.
2. Require that all aircraft operating above 10,000 feet be equipped with altitude-encoding transponders.
3. Raise the tops of all existing Terminal Control Areas (TCA's) to 10,000 feet MSL.
4. Expedite the designation of Airport Radar Service Areas.

But these all require regulatory action which, historically, is a slow process. Several other recommendations which we provided are still under review, and no action has been taken. Some of these are to:

1. Require all controllers to initiate computer tracks on *all* aircraft above 12,500 ft.
2. Require the mandatory issuance of traffic advisories to air carriers operating above 12,500 ft.
3. Implement additional TCA's at those airports now having qualifying traffic counts.
4. Expedite the development of the TCAS III, with its horizontal resolution advisories.
5. Formalize training in visual scanning techniques and disseminate the techniques to all users, particularly air carriers, for inclusion in recurrent training.
6. Expand the controller work force.
7. Expedite the development of a cockpit display of traffic information (CDTI), which could be used to provide "situational awareness" in air carriers.
8. Require the design of improved windshield visibility in air carrier aircraft.
9. Require strobe lights on all aircraft.

We believe all of our recommendations are directed toward enhancing the safety of the ATC system and most can be implemented with a minimum economic impact on the users. Our goal, like yours, is to increase safety in the air traffic control environment.

[Attachment]

IMMEDIATE ACTION

1. Initiate an emergency change to FAR Part 91 that would require all aircraft carrying transponders to turn them on in flight.

Rationale: FAR 91.24 requires operating Mode C equipped transponders for aircraft above 12,500 ft. and in Terminal Control Areas (TCAs). While the Airman's Information Manual states transponders "should" be operating while airborne, it is not a regulatory requirement in airspace other than that listed above. Establishing such a requirement would aid safety in the National Airspace System by providing a higher degree of VFR target visibility to radar controllers in ARTCCs and terminal area facilities. While the immediate benefit of this change would be as just described, a concomitant feature for future use would be the additional protection provided all TCAS-equipped aircraft whose system effectiveness depends on transponders for threat detection.

2. Require all controllers to initiate computer tracks on all aircraft above 12,500 ft., so as to derive maximum use of the "conflict alert" feature of the ARTCC computers, which can be the genesis of a safety advisory.

Rationale: Since all aircraft above 12,500 ft. are required to operate a Mode C equipped transponder, the ATC system has the capability to generate computer tracks on these aircraft if controllers initiate them. Such tracks would be subject to the automatic "conflict alert" feature of the ARTCC computers and thus a vital safety service to aircraft operating in this airspace.

ALPA would favor an even more extensive use of this capability by having all Mode C equipped aircraft entered into the system, regardless of their altitude or type of flight plan. We recognize that controller workload and computer capacity may not permit adoption of this concept at this time, but it must be an FAA goal for the future.

3. Require the mandatory issuance of traffic advisories to air carriers operating above 12,500 ft.

Rationale: Flight Operations conducted above 12,500 and below FL 180 are subject to a mix of IFR and VFR traffic not constrained by the 250-knot speed rule, which applies below 10,000 ft. Many of the VFR aircraft operating in this higher altitude structure are not in contact with ARTCC controllers, but thery are displaying transponder codes with altitude reporting. Thus for all practical purposes they are "known traffic" to ATC and they are often subjects of traffic advisories. Realizing controller workload may prevent the issuance of traffic advisories to all aircraft operating in this higher altitude structure, available resources should be allocated to those flight operations carrying the maximum number of people. This means the air carriers. Controllers should prioritize traffic advisories, and issue those that involve traffic in close proximity to air carriers on a mandatory basis.

NEAR-TERM

1. Implement additional TCAs at those airports now having qualifying traffic counts.

Rationale: Following the designation of the current group of existing Terminal Control Areas, a moratorium on this type of airspace action was declared by the FAA. Since that itme, the traffic activity at several airports may have reached the criteria used in establishing the current TCAs. To ensure that an equal level of safety is provided throughout the National Airspace System, the FAA should again survey all major air carrier airports to see if any meet the criteria used for establishing current TCAs. and if so, initiate airspace action to establish them where required.

2. At other busy air carrier airports, expedite the designtion of Airport Radar Service Areas (ARSAs) similar to the type now being tested in Texas and Ohio.

Rationale: There are many airports having a significant number of FAR Part 121 and 135 operations that, while not meeting original TCA requirements, should be afforded a higher degree of ATC service than is currently being provided. The Airport Radar Service Area (ARSA) concept now in use at Austin, Texas and Port Columbus, Ohio appears to be an excellent means of elevating the level of safety at these locations without imposing unreasonable operating constraints on other elements of the aviation community. The ARSA concept is less restrictive than TCA requirements, but more efficient than the rules governing Stage III Terminal Radar Service Areas (TRSAs).

A significant number of airports served by air carriers, and some with a high number of schedules commuter flights, still do not even have control towers, let alone ARSAs! The FAA should initiate immediate action to eliminate this obvious safety deficiency and to provide such service to communities now having to contend with this problem. ALPA encourages the FAA to move quickly on contracting with the private sector for VFR towers at these locations. Contracting for these services can provide significant cost savings for the federal government, and the level of safety to the public would be raised considerably.

3. Revise current rules to require Mode C equipped transponders for all operations above 10,000 ft.

Rationale: At the present time, FAR 91-24 requires Mode C equipped transponders only above 12,500 ft. FAR 91.70 authorizes speeds above 250 knots when operatign at 10,000 ft. or above. In that 2,500 ft. altitude structure, operations can be conducted at high speeds that reduce a pilot's ability to "see and avoid." Air traffic controllers are deprived of essential altitude information from VFR aircraft that could be used to provide traffic advisories to aircraft operating within the ATC system. Revising FAR 91.24 to require Mode C at 10,000 ft. ana above would provide compatibility with FAR 91.70, enable controllers to assist pilots in meeting their "see-and-avoid" responsibilities, and at the same time, elevate the level of safety provided the traveling public.

4. Concurrently, raise the top of all existing TCAs to 10,000 ft.

Rational: At the present time, there is no standardized top altitude for the existing TCAs. Some terminate at 7,000 ft., others higher, based on local airspace configurations and TRACON/ARTCC letters of agreement. This is another example of the nonstandard airspace configurations within the National Airspace System. If

FAR 91.24 were revised to require Mode C transponders for all operations at 10,000 ft. and above, and the top of all TCAs were raised to that level, air traffic controllers would be provided the opportunity to have precise information on all traffic that could affect the safety of air carrier/commuter arrival and departure flights at TCA-designated airports and thus afford a majority of the traveling public a higher degree of safety. This concept would also serve to standardize airspace configurations throughout the NAS and thus help remove any misunderstandings by general aviation pilots about the configuration of TCAs.

5. Expedite the development of the Enhanced TCAS II, with its horizontal resolution advisories.

Rationale: The development of an effective airborne collision avoidance system is long overdue. While the TCAS family offers many advantages over earlier designs in terms of independence, equipment, and cost, and while it has even found support in international aviation communities, its development is currently stymied within the FAA. The problem relates to the vertical-only resolution capability of the Minimum TCAS II. On the other hand, the Enhanced TCAS II version offers the capability for more accurate bearing information and both horizontal and vertical resolution maneuvers, and it is much more appropriate for airliner installation. Thus, the FAA should increase the emphasis on the latter version since the simpler version is inadequate for airliner needs.

6. Formalize training in visual scanning techniques and disseminate to all users, particularly air carriers, for inclusion in recurrent training.

Rationale: FAR 91-67 requires pilots to "see and avoid" other aircraft in VFR weather conditions. The effectiveness of this concept has been challenged in reports by the National Transportation Safety Board and other informed factions of the aviation community. Since this philosophy will continue to be a part of the overall safety scheme, an effective and standardized technique of visual scanning should be developed, documented, and taught to pilots. This information should become a mandatory part of air carrier pilot recurrent training and the biannual flight review for general aviation pilots.

7. Expand the controller work force.

Rational: One of the major constraints in system capacity is the lack of qualified controllers. This deficiency also directly impacts the capability of the ATC system to provide safety-related services such as traffic and severe weather advisories. Considering the impact this shortage has, an expansion of the size of the ATC work force is in order. When compared to 1981, right now about 70 percent of the controller work force is handling 110 percent of the traffic. Controllers are working overtime, without vacations, and without adequate sick leave availabilities.

There is a need for more controllers, and there are four and only four means of satisfying this requirement:

1. Hire and train new personnel,
2. Retain potential retirees,
3. Cross-utilize personnel on hand,
4. Rehire some former controllers.

Each option has advantages and disadvantages that must be evaluated by the FAA to achieve optimal effectiveness. ALPA has not made such assessments, and does not intend to do so; they have only identified the options, but ALPA would support the FAA in whatever option(s) it chooses.

LONG-TERM

1. Expedite the development of a Cockpit Display of Traffic Information (CDTI), which could be used to provide "situational awareness" in air carriers.

Rationale: The FAA's goals of improved ATC services through consolidation and automation mean that human monitoring of traffic situations by controllers will be diminished dramatically. As an alternative to this undesirable consequence, the display of traffic information in the cockpit would allow the involved flight crews to monitor their own traffic situations. It would also allow crews to maintain sequences and refine separations as established by the ground-based system. Pilots do not want "do-it-yourself" ATC, but they do want someone to be available to intervene if necessary, and if the FAA drops that function, the pilots will have to pick it up.

2. Require the design of improved windshield visibility in air carrier aircraft.

Rationale: FAR Part 25 requires derivative aircraft to meet only criteria in effect at the time the original design was filed with the FAA. Thus several models of aircraft can evolve that do not take advantage of state of the art developments to improve safety. One prime example is windshield design. Aircraft are being built today that meet criteria acceptable in the 1950s. Today's engineering would permit vastly improved cockpit visibilities; but to save cost on cockpit redesign, no such improvements are made to these derivatives. Meanwhile traffic densities increase, separation standards are reduced, head down cockpit programming workload increases, and yet the FAA hangs on to the "see-and-avoid" concept as a primary tenet of traffic separation, with still no effective collision avoidance system being available.

3. Require strobe lights on all aircraft.

Rationale: In VMC conditions, todays air traffic system relies primarily upon the "see-and-avoid" principle. Even flights operated under IFR are expected to see and avoid other VFR aircraft. With todays increased traffic, especially in terminal areas, strobe lights can assist pilots in visually acquiring other aircraft. In a see and be seen environment, a few seconds can be important in giving the pilot sufficient time to avoid a collision considering that even below 10,000 ft., closure speeds can be as high as 500 knots. The majority of commercial and general aviation aircraft are already equipped with strobe lights, and the costs for retrofit of these anti-collision lights should not have a major impact on aircraft owners since such lights are readily available and prices begin at about $200.00 for general aviation aircraft.

These recommendations have been discussed in detail with the FAA, and we are encouraged by the manner in which they are received and addressed. Also, all of the recommendations listed as "Immediate Action" have been submitted through the FAA's National Airspace Review process.

There is one additional recommendation I would like to make, Madam Chairman. It is a recommendation to the Senate and your colleagues in the House of Representatives. We recommend that you adequately fund the FAA program for improving the Air Traffic Control System. This program was initiated by Administrator Helms in 1982, and we believe it is the only way in which we are going to assure adequate ATC system and airport capacity in order to satisfy the public demand. We realize that securing such large dollar amounts in today's cost-conscious environment is extremely difficult. However, you must remember that funding for these ATC improvements is primarily being paid for by public, airline, and general aviation sources. Taxes from these sources have produced a surplus in the aviation trust fund of over $3 billion. We must ensure that this money is spent as it was intended when this special trust fund was established.

FAA INSPECTION PROGRAM

One of the problems facing the air transportation system today is the inadequate number of inspectors employed by the FAA to inspect and certify the air carrier and commuter airlines and its effect on the FAA inspection program.

When a large number of new entrants enters our national air transportation system, and the FAA Inspection Division is called upon to certificate those new entrants while at the same time continuing to monitor and inspect those operations already assigned to an inspector, some areas must suffer. Compound this problem by the overall reduction in the number of FAA inspectors between 1979 and 1985, and you have all the necessary ingredients for a significant safety problem.

To provide you with some perspective into the problem, please review the following figures taken from FAA-supplied data or from conversations with FAA personnel:

In 1979, there were approximately 2,012 FAA inspectors assigned to 237 air carrier, commuter, and air taxi operators. 537 of these inspectors were assigned to the 83 Part 121/125 large aircraft air carrier operators.

By the end of 1982, the number of inspectors had been reduced from 2,012 to 1,735, a 14% decrease, while the number of operators had increased from 237 to 389, a 64% increase.

By March of 1984, the number of inspectors had been reduced even further to 1,332, a 34% reduction over 1979, while the number of operators increased to 407, a 72% increase over 1979.

Although there has been a slight increase in the number of FAA inspectors in the past year, the present number of inspectors continues to lag 27% behind that of 1979, while the number of carriers operating today is 122% over the 1979 number.

In addition to the above, consider that for each new entrant two FAA inspectors must devote their full time, for a period of approximately 45 days, to certifying the new entrant's maintenance, training, flight operations, manuals, ets. These are inspectors that are also assigned to inspect other air carrier or commuter operators on a routine basis. However, during the period they must devote all their time to certifying the new entrant, their normal duties cannot be performed. When you realize that duing the period 1980 to 1985 the FAA had to certify 76 new air carriers and

233 new commuter airlines, they spent approximately 27,000 man-days just certifying new entrants. It then becomes obvious why so many routine items are going unnoticed by the FAA inspectors: they are simply too busy certifying new entrants and then taking on additional workloads once the new entrant is certified and operating.

In an attempt to improve the situation without increasing manpower, the FAA has shifted some general aviation inspectors back and forth between commuter operators and air carrier operators, far beyond their level of experience. This became necessary as more commuter operators expanded and began to use large aircraft. The significance of this problem first became apparent to us in early 1938 when our members reported that general aviation inspectors were performing the duties of air carrier inspectors. We brought this to the attention of the FAA on several occasions, receiving the standard response, "We are trying to utilize our inspectors in the most efficient manner."

Our members have been reporting to us for a number of years that they see more and more maintenance discrepancies being deferred for longer periods of time. This means that more aircraft are carrying passengers for longer periods of time with inoperative equipment on board. The FAA and the operator will tell you there is a Minimum Equipment List on board aircraft that authorizes the flight to continue with inoperative equipment. However, this Minimum Equipment List was only intended to get the aircraft to a maintenance base without disrupting the schedule and causing inconvenience to the passengers. Nevertheless, we have evidence of numerous repairs being deferred for 30 to 60 days before proper maintenance is scheduled. One airline informed its flight crews that all equipment failures listed on the Minimum Equipment List could automatically be deferred for 30 days because of lack of manpower and spare parts availability. If at the end of the 30-day period the airline was still experiencing manpower or spare parts problems, the failure could be deferred for an additional 30 days. Another airline recently put out a memo to its flight crews that maintenance would be conducted on deferred items only if it didn't disrupt service.

These conditions should not surprise anyone who followed the discussions concerning deregulation. FAA internal memos at that time forecast inspector shortages if the FAA did not make great strides in hiring more inspectors and having them trained prior to the great expansion anticipated. At that same time, the FAA hierarchy was telling Congress and the world that they had an adequate inspection force to deal with deregulation.

Deferred maintenance is just one of many areas where the shortage of FAA inspectors has resulted in a degradation of safety on the airlines. We see similar degradation in most areas where an FAA inspector is responsible for monitoring and approving airline activities.

We recognize that Secretary Dole has approved the addition of 500 FAA inspectors, and we applaud this action. However, in order to provide the same capability that existed in 1979 (2,012 in spectors for 237 operators), we need an additional 2,453 inspectors. Keep in mind that the number of operators has increased 122%.

We believe it is obvious from the evidence offered that a great many more qualified inspectors are necessary to ensure a safe air transportation system. We are confident that with your leadership necessary funds and manpower will be restored in order to improve the level of safety for passengers and crews.

Thank you for the opportunity to comment.

Senator KASSEBAUM. Thank you, Captain McNair.

Mr. Jones, you mentioned that the great variability in air traffic was very much a factor in controller morale. The greater the variability, the lower the morale.

Would you be in favor of flow control and restricting air traffic?

Mr. JONES. I think one of the recommendations that I made in 1982 and repeated ever since is that all the policies for running, managing and governing the airway system should keep in mind that our goal is to level the use of the system and not to allow unconstrained peaks and valleys to occur.

It is, again, the larger the variability that we allow, the more problems we are going to have managing the system, affording the system, and keeping it as safe as I think it is clear that we would like to see. And flow control is certainly one process of leveling.

Senator **Kassebaum**. Let me say, I hope anybody on the panel will feel free to offer comments. I assume, Mr. Fleming, that you might have some reservations about limiting air traffic. However, I think in the testimony that we have heard this morning, the concern about being able to handle traffic loads has been expressed by nearly everyone, and certainly the concern about the air traffic control system dates back even prior to the strike.

Mr. **Fleming**. It surely does, Madam Chairman, and we have heard this morning, for example, from our GAO witnesses about some of the preliminary results of their questionnaire with which we were not familiar prior to this hearing. And it remains to be seen what the results will be after they are analyzed.

You are correct, however, in assuming that the airlines would not agree that the system should be designed such that the way you operate is to level out the flow of traffic, because that is not what the passengers want, and we are in the business of providing service and I think the Administrator made it clear that he, too, is in the business of providing service.

However, there may well be additional things that need to be done to ensure that the controllers have the resources that they need to do the job properly. and that there are enough of them, and we have, as I mentioned in my statement, pressed the FAA in the past to improve the controller staffing level, because it takes a long time to produce a trained, fully qualified controller. And if you have a problem today, in fact, you needed to foresee that shortage 3 years or so ago. And we feel strongly that if the agency is ever to catch up with its needs, it must plan adequately for the future. It must be willing to come and ask for the resources that it needs.

Now, we all recognize that in times of tight budgets that is a formidable challenge. One of the things that concerns the airlines greatly is that as the budgetary pressures inevitably come to bear, that for example the FAA's facilities and equipment account will be nibbled away, which in turns means that the national air space system modernization plan is in danger of slippage, and that in turn will affect——

Senator **Kassebaum**. I do not think that is what is in danger of slippage.

Mr. **Fleming**. If I might say a few more words, the administator has stated unequivocally the major elements have not slipped, and that is clear, but there are subsidiary programs which are beginning to show signs that they may. The whole thing is interrelated, and we may be facing problems starting in 1987. I do not think we see it this year, in this fiscal year.

Senator **Kassebaum**. Captain McNair, does ALPA think it is a question of numbers?

Mr. **McNair**. Chairman, it is partially a problem of numbers. I think what we are going to have to get away from in this country and something that has predominated since deregulation is what I call aviation "on the cheap." It is going to cost some money, and the philosophy behind the deregulators, which was an economic theory, not an operational theory, is that everything is going to be less. After the strike of 1981, the air traffic control system was going to be operated cheaper, and that is just not correct.

We are going to have to spend some money, we are going to have to hire some people, we are going to have to provide some meaningful jobs, and we are going to have to tell people that when we hire them as air traffic controllers, we are not going to replace them with a computer 5 years down the line.

Otherwise, if you tell them that, you automatically destroy their morale.

Senator KASSEBAUM. It seems to me that we face a transition period while the NAS plan is implemented. That obviously is something that we cannot overlook as we plan ahead. Wouldn't you agree?

Mr. RYAN. Madam Chairman, may I make a comment?

Senator KASSEBAUM. Yes, Mr. Ryan.

Mr. RYAN. Since August 3, 1981, when we lost 11,400 controllers, we have hired and trained over 12,000 controllers and sent them through Oklahoma City. Today, our goal is 14,306 total developmentals and full performance controllers—we have a goal of 11,285 operational controllers, of which we have 10,408 on board. We need to go another 800.

With regards to this past summer and the morale of the controllers, working overtime is a difficult thing. And that relates to the shortage of the 800 controllers that we are now presently training to attain the goal of 11,285. In order to accomplish that, I agree with both Chairman Burnett and Mr. Jones and the gentleman from ATA.

Last fall, we put into effect flow control procedures in anticipation of increased traffic this summertime. It was accomplished with controlled departure times. When demand exceeded capacity in the system at certain airports, aircraft have to take delays on the ground so that they can be accommodated in the system.

Unlike before, the 1981 and the strike when 55 percent of all aircraft delayed were held in the air, it is now less than 10 percent and we intend to keep it that way, so that when aircraft cannot be accommodated, they are held on the ground.

We have established traffic management units at each of our 20 air traffic control centers, and in the New York terminal radar control facility. The main function of these traffic units is to match demand with capacity in those particular facilities.

The central flow control facility in Washington, DC, on the sixth floor in Headquarters oversees this vast network which matches demand with capacity. We have recently increased the staff at the central flow control facility by approximately 40 percent to cope with that demand capacity oversight, and also to implement a new management philosophy, if you will, of straight line or operational line authority that begins and emanates in FAA headquarters straight to our air traffic control facilities.

So I think in a number of different ways, we are keeping with various different kinds of philosophies. But there is one question I would like to ask Mr. Jones. In the GAO report there was mention of a question that said that collectively, controllers would like to work 3.68 hours in a day out of 8, and I wonder if that fits with the variability theory that Mr. Jones put forth in Jones I.

Mr. **Jones**. By the way, I agree in support of what I thought was both a very thoughtful and very accurate, from my point of view, review by Jack.

The question that has come up earlier about the work flow, we investigated that directly in our work in 1982, and particularly in our personal interviews with people throughout the country, involved working in the system, and we did that again on a more limited basis in the summer of 1984.

The question of whether from the controller's point of view, he or she feels that they are working more than they should be and that they were working more appropriately in terms of the balance of time back in 1981, those who had experience base there, I think you have to recognize that about 4 hours on, 4 hours off that existed in 1981 was in part recognizing for 2 years prior to that, on both the part of PATCO and the part of FAA, that there would be a strike.

The system, as people knew it who worked in it, almost unanimously told us that it was overstaffed. The FAA had more people in there purposely because they knew they had to have a plan to operate if they lost some of them, and for their own strategic purposes the union also had encouraged overstaffing.

So we find also that in talking with the controllers, that their most unhappy periods are when they are not controlling traffic. They like to do the work. So I don't believe we would ever find any useful conclusions from arguing the 4/4 or the 6/2. You have got to break that work into its component parts. And it really depends, whether you are working 4 hours or whether you are working 6 hours, in my opinion, on what is the character of the workload within that period of time?

How much of that time are you sitting around, not really going apace, and at what point in time, if any, do you have a feeling that the work coming immediately toward you is more than perhaps you are prepared to handle? That is the key thing.

I would think from the earlier discussion, that we know that the 4 and 4 of 1981 was not sufficiently efficient. We may be discovering that the 6 and 2 that has been existing more recently may be trying to push it too far. So probably, I heard—at least it was my judgment that Admiral Engen was saying this morning that probably, as we work with this, we will find that the right answer is somewhere in between.

I do not know that I answered the specific question you had.

Senator **Kassebaum**. Mr. Kelley, before you leave, I know Mr. Jones has to leave to catch a plane shortly.

Mr. **Jones**. It may be late, so——

Senator **Kassebaum**. I would just like to ask before you leave, if you think that it is controller numbers that are a problem at this point. NTSB Chairman Burnett testified earlier that he thought that it was a question of supervisor control and formalized procedures.

Did you find, as you analyzed the system, that there were procedures that had not been formalized, and some uncertainty as far as what the supervisors should be doing throughout the system?

BEST COPY AVAILABLE

Mr. Jones. I don't think that I can recall that we found anything particularly useful either in 1982 or 1984 that would relate directly to your question, Madam Chairman.

The system was very rigid. It was very much reduced to A-B-C kind of thinking, and if it suffered any, in respect to your question, it was probably a little too rigid, not able to flex as much as it appeared common sense would tell you to do when faced with a particular situation.

So the managers were always faced with following the book and staying out of trouble or leaning a little and taking care of the problem and perhaps getting disciplined for it. That is probably true in any organization, more or less, and I don't think it was dysfunctional, at least when I saw it in operation.

Senator Kassebaum. I would like to ask your thoughts on the administration's suggestion that nearly 2,000 controllers be given a two-grade promotion in 1 year. There has been some concern expressed about them being moved ahead that quickly. Could that acceleration lead to inexperienced controllers being placed in very crucial positions too soon?

Mr. Jones. Yes; I agree with the underlying statement. I have always found it true of everybody within the FAA that safety in the air system is their first and foremost priority. That is not just a pep talk; we found it to be true, and I think documented it again and again.

Senator Kassebaum. So you would have some concern with that recommendation.

Mr. Jones. I would have concern with the recommendation in terms of being able to allow the system to grow, particularly if that growth created higher peaks and less leveling. Taking care of peak traffic requires seasoned air control specialists.

If we suffer from anything today in this point of the rebuilding process, it is a very able group, a very dedicated group of folks as we found them, but it is certainly not yet a seasoned work force. And just putting another couple of thousand of unseasoned people in there is not going to solve it.

Senator Kassebaum. Are there any further questions for Mr. Jones before he leaves?

Senator Exon. I might have a question. I have been listening with great interest, and I got into that matter of 4 and 8, 5 and 3, and 6 and 2, and all this. I think that is the kind of critical issue that we have here, first from a standpoint of safety, and second, from the standpoint of morale.

If the morale is not up, I suspect we are not getting full efficiency as far as air safety is concerned, which is uppermost in all of our minds.

Gentlemen, let me ask you this question so I can understand it. O'Hare is the busiest airport in the United States? Atlanta next? Is that right?

Mr. Ryan. Yes, sir.

Senator Exon. Who is third?

Mr. Ryan. Los Angeles.

Senator Exon. Next? Where does National come in—8th, 10th, 11th?

Senator **Kassebaum**. When you go through St. Louis, you feel like it is the busiest.

Senator **Exon**. Every airport you go through is the busiest one. What I was getting at is this, is there proper distribution of the available air traffic controller personnel? Again, I am not an expert, but I guess if I were an air traffic controller, probably the best time to work National Airport would be starting on the shift about 8 o'clock at night, then work for a couple of hours when they can't fly anymore, and then be off the rest of the time.

If I were in airport that was operating around the clock, I suppose the least stressful time would be from the period from midnight to 8 o'clock in the morning.

Is there proper distribution of air traffic controllers within a given airport that is open 24 hours, and is there proper distribution of the available experienced personnel that we have between the various airports?

Putting it another way, in your opinion, are we making correct management decisions as to where our experienced people are working most, or do we have a situation where someone is drawing essentially the same salary with the same time in grade, working 6 feverish hours, as someone else in some other location might be working half as much time? Is there balance?

Mr. **Ryan**. OK, sir. There's about a half a dozen questions there, and I will answer the last one first. With regards to complexity and volume of traffic, we have established five different levels and different pay at terminal facilities or air traffic control towers, the most visible part of our air traffic control system.

Senator **Exon**. So that means if I were an air traffic controller at Washington National, I would be getting paid more than an air traffic controller at some smaller place where they do not have the traffic load?

Mr. **Ryan**. That is true. The air traffic controllers at Washington National, at O'Hare, at Los Angeles, at Atlanta, Miami, are generally in the same category. And the air traffic controllers at St. Louis have just gone into that higher category.

With regards to distribution around the clock within a facility, the local facility manager certainly has the authority, and I have no reason to doubt that he is using it to distribute those folks throughout the 24-hour period. And with the exception of a facility or two in Indianapolis, because of Federal Express and UPS and a lot of folks that fly at night, generally speaking, the midnight watch is the one that has the least staffing of the other two shifts.

With regards to distribution among over 400 facilities, it is not absolutely perfect, and you would imagine that because of attrition rates due to training and retirements, that one facility more than another may be slightly affected.

And with regards to the number of full performance level controllers or experience, we have a problem more at two large facilities which would be Chicago and New York, than we may do at—and these are center facilities, not tower facilities—than we do in other places.

As I mentioned earlier, we still lack some 800 controllers to bring us up to our operational controller goal of 11,285 and we are certainly working hard at doing that. But flow control will keep the lid, if you will, on traffic in certain areas and spread out that traffic throughout an 8-hour shift, so that hopefully no air traffic controller or sector is overburdened.

Senator **Exon**. One more question along that line. An air traffic controller that is working in Omaha, NE, let's say, you are going to need an air traffic controller in Washington National, for example.

Do those air traffic controllers have the right to say whether they want to go or not, or can they be transferred arbitrarily?

Mr. **Ryan**. We use the bid system. If we have an opening at Washington National, for instance for a GS-14 controller, and you are a GS-13 somewhere or a GS-14, if you would just like to change locality, they will put out a bid that says we need one, two, or three people and you may bid on that and management folks will pick out the best controllers to go to Washington National.

We have not adopted, nor do I know that I want to, forcing people to go from one place to another.

Senator **Exon**. And that has not been a particular problem as I understand it?

Mr. **Ryan**. No, sir. We have never used that technique of moving people. We have tried to use incentives to have people go where we have had vacancies through one way or another.

Senator **Exon**. Thank you. And thank you, Madam Chairman.

Senator **Kassebaum**. Mr. Kelley, you had a comment to make.

Mr. **Kelley**. Well, Madam Chairman, back when we were discussing the merits of the 4- or 6-hour shift, I thought one issue that might be of interest to you as far as the safety board is concerned, in our air traffic control studies that we did subsequent to the strike and some of our accident and incident investigations that we have done since that time period, we have been concerned about the fact that the FAA did not have in place a formalized program whereby supervisors could monitor, detect, and measure stress on controllers.

We made recommendations to the FAA concerning this, and I believe that as of right now, we are still not satisfied that the FAA has implemented a program which will adequately be able to detect and monitor stress. Stopping short of taking a position on whether 4 or 6 hours is the proper amount of time to work, it seems to be that embodied in implementing that program would be to have in place a real formalized program, so that you are able to detect stress in controllers if they are working a longer period than they had previously, stress becomes a very active part.

Senator **Kassebaum**. That was Mr. Burnett's point when he spoke of formalizing some of the procedures on the part of the supervisors.

Mr. **McGrail**. Madam Chairman, I might add that controllers are not asking to work less hours a day. It is the distribution of those hours. The 4- to 6-hour discussion gets to how much time working a radar position versus how much time either giving training or receiving training, or working in nonradar position.

By and large, the controllers are saying they feel that they should work, either working radar, the training, or working nonradar position, over 6 hours a day.

The facility managers also feel that the time the controller should spend working radar should not be any more than 3 hours.

Senator **Kassebaum**. Mr. McGrail, in the GAO survey did you address the question of what the controllers would think about bringing back any of the PATCO strikers?

Mr. **McGrail**. No, we did not, ma'am. We did get thousands of pages of written comments along with our specific responses to our questions which we have to analyze yet. And I would like to mention that I have read several hundred of those comments so far. There is one predominant theme I see, and that is a sense of frustration and skepticism on the part of the controllers that something will be done, that people will listen to them.

They allude to the prior studies that have been made, the Jones and others, and they are waiting to see what happens, both in response to these hearings and our study.

Senator **Exon**. Madam Chairman, the thing that comes through very loud and very clear to me—and Mr. McGrail, you just brought it out once again—we heard testimony this morning that indicated they are on 6 hours and off only 2 hours.

You just said that the professionals seem to think they should not be on any more than 3. Now, I suggested should it be 5 to 3. What should it be? What you are really telling me—and I am wondering if the rest of the panel could just give me your off-hand opinion—it is pretty serious, I think, when we receive testimony here that some people say they can work 6 hours, and you say that experts don't think they should work any more than 3. That is double.

It seems to me that that may be one of the Achilles heels that we should address even more specifically than we have. What do the rest of you think—without taking a stand?

Let me ask you this way. Do you think they should work 3 hours or do you think they should work 6 hours, or which are you closest to?

Mr. **Kelley**. Senator Exon, again I would like to stress that I think a very important ingredient in the system is the supervisor, the supervisor being on position and monitoring the controllers.

Now, I am not going to take a position on whether it should be 4 or 6, but I suspect that one controller can work longer hours and not be impacted, and another controller probably should be given relief at a lower number of work hours, and that is why I think it is very important for the supervisors to be trained so that they can detect the onset of stress and make appropriate relief to those positions.

We found in some incident investigations involving air traffic control and near mid-air collisions that the controllers had been on the position for an extended period of time; they had not had additional staff to help them out; and the control situation became out of hand before the supervisory element came in and provided adequate relief.

So I think an important ingredient, in answer to your question, is a very well-trained supervisor on the scene.

Senator **Exon**. Captain, do you think 3 or 6, or somewhere in between?

Mr. **McNair**. Senator Exon, if it is the same across the United States, it is automatically wrong. It depends on what the man is doing. If he is on the mid watch in the Seattle Center, he probably can stay on a radar position a lot longer than if he is on Washington approach control at 6 p.m.

Senator Exon. How is it now? Is it different?

Mr. McNair. I think Mr. Ryan could answer that better than I can. But it cannot be a national standard that people are going to do the same thing in all facilities for the same number of hours of the working shift.

Senator Exon. Back to my earlier question, that I assume the stress is at different levels. Is that what you are saying?

Mr. McNair. Absolutely. And also, I think Mr. Ryan will state that there have been a number of operational errors that have occurred in the system during periods of low activity, when boredom sets in and things tend to slip a little bit, and that has to be addressed also.

So it is a very difficult question, and I don't think that the FAA can come up with a national standard and should not come up with a national standard, that you will sit in front of the radar scope for 3 hours and 19 minutes at all facilites. That is not the answer, sir.

I hope that has helped. I am not sure that it has.

Senator Exon. That is helpful.

Mr. Fleming. I agree basically with the remarks made by Captain McNair. Even within a center, for instance, there would be a great deal of difference between a center control sector manned by a controller or a team of them that is handling primarily departing and arriving traffic, climbing and descending with crossing traffic, compared to a controller in Albuquerque Center, who is basically handling overflights from the east to the west coast.

And that is just one small example of the kind of factor Captain McNair had in mind. Neither he nor I are expert air traffic controllers. Mr. Ryan is. But it seems to me there has to be some commonsense factored in here.

Senator Exon. Well, tell me this. And maybe you can answer this, Mr. Ryan, if the rest of you cannot.

The testimony from Mr. Engen this morning was that the standard is 6 hours on and 2 hours off. Is that 5 and 3 in some places now, and 4 and 4, or is 6 and 2 across the board?

Mr. Ryan. Oh, I think the 6 and 2 is an average; 6 and 2, just as 3½ to 4 was an average before the strike. I think the important thing is from a planning standpoint, you have to assume when you hire somebody and create a sector that needs three people on the day watch and three people on an evening watch and maybe one on a midnight watch, that in your planning standard and in your staffing standard, you plan that this person will be there so much of the time.

If your planning is that he is only going to be there 4 hours of the day and you feel that there ought to be three people working that sector at all times, well then, you better hire six people for that day watch. And the same for the evening watch.

Now, the standard we are using for planning is 6½ hours on a sector. That does not mean that the supervisor ensures that every controller working for him, by golly, will work 6 hours and 30 minutes for sure. That is not done.

I think the important thing in all of these comments and discussions about that is that we do have a recommendation in the employees' handbook that a controller should not stay on a busy position more than 2 hours. I think that is important, that he get out and move around, take a coffee break.

And certainly the captain is absolutely correct. You may be able to sit on a position on a midnight shift in Seattle by yourself, not with the two other people or one other that may be there on the day watch, because there are no complexities, there is no pressure, there is no stress.

On the other hand, if you are sitting somewhere else, in Indianapolis Center on a midnight watch, working Federal Express and UPS and all those folks that are moving packages around, you may need to be relieved on a midnight watch after an hour or an hour and a half. And I think my own personal standard as supervisor is, I would not want to leave people on more than an hour and a half, and what you need to do, if nothing else, just change their perspective and view. Take them off a radar position and put them in a nonradar position so that their activities will change.

And by virtue of that, I think productivity can be maintained.

So I don't think there is any set number.

Senator EXON. Thank you.

Mr. McGRAIL. I could add something about controllers spending time in position without a break. Our data shows that 49 percent of the controllers are spending between 2 and 3½ hours on position without a break, and 62 percent of controllers feel that is much too long.

Senator EXON. Thank you. Thank you, Madam Chairman.

Senator KASSEBAUM. Thank you.

Mr. Ryan, I would like to ask you about the addition of 1,000 air traffic controllers that Secretary Dole announced would be brought on board in the next 2 years. It is my understanding that the dropout or failure rate at the FAA Training Academy is about 50 percent.

Is that correct?

Mr. RYAN. Yes, ma'am.

Senator KASSEBAUM. Does this mean that we will really have to start with about 2,000 new controllers in order to end up with about 1,000 at the end of 2 years?

Mr. RYAN. No. We intend on putting through the academy or hiring approximately 40 a month for the 12 months.

Senator KASSEBAUM. But in order to get 40 per month, are you going to have to start with double the number in order to obtain the 40 that you really would like to see as new controllers?

Mr. RYAN. I think the number traditionally has been a 50-percent washout rate, but in fact, starting today or tomorrow, we have a new screening process which we hope will in fact have a higher yield than the 50 percent we are getting now at the academy.

As it is, the 480 for 1986 notwithstanding, there are 2,000 that we will put through the academy in any event to get somewhere near 1,200 or 1,300 with the new screening techniques, which will take care of our attrition due to retirements, which by the way traditionally are nowhere near as high as what has been expressed in the survey of GAO.

We have had 401 retire in 1984. We predict about 450 for this year, and we predict about 490 for fiscal year 1986.

Senator **Kassebaum**. These are your experienced personnel, is that correct?

Mr. **Ryan**. Yes, ma'am. That is true.

Senator **Kassebaum**. NTSB has commented on the supervisors, and the importance of experienced personnel.

Is there anything that you can think of that should be done to prevent this situation from happening? I asked Admiral Engen earlier whether we should look at ways to perhaps grandfather-in retirees in order to make it more attractive for them to stay in the system. Have you assessed whether that would make any difference?

It is losing that experience that must cause some concern.

Mr. **Ryan**. It certainly does. I think one of the fears of the air traffic controllers—and I have not had a chance to see the survey—that may be expressed in there is the fear that the Civil Service Commission retirement will be changed.

Now, the controllers, and I believe some Federal enforcement officers are unique, that they can retire at 25 at any age, or 20 years at age 50, as opposed to 55 for myself.

I guess they would hope that that would be vested irrespective of what plans may be made for civil service retirement and, quite frankly, it has them worried. If something were to happen by January 1 of next year that would include them and raise the age to 65 or wherever it eventually may be, certainly that would cause an exodus of people who are eligible or over 50 years, so that they would not be charged the 5 percent or 2 percent a year for retiring under 62 or 65.

So that is certainly—and it is one of the highest priority things that they speak of when you talk to them about what is going to happen with the retirement. Am I going to be included? Are controllers going to be included?

So that is certainly a worry, and I am sure that is a factor in driving the number of the percentage higher in the numbers that GAO cited in their survey.

Senator **Kassebaum**. Captain McNair, I would just like to follow up. You mentioned, and you addressed it forcefully, the TCAS system. I know NTSB has recommended it. I think FAA has some reservations about it. I wonder, while you are all right here, if you could discuss the differing views. Is it just the expense of doing this at this time, or is there a question about the system's effectiveness?

Mr. **McNair**. Well, we have had some problems, Madam Chairman, with the TCAS 2. The terminology then became enhanced TCAS 2. We thought that just confused the whole issue. We are now into TCAS 3.

TCAS 2 only provided vertical escape maneuvers. We did not feel that those were sufficient. We have seen some lethargy and dragging in the FAA from the standpoint of the legal liability of this whole thing. When we ultimately put it in an airline cockpit, with passengers, and try it out en route—which we are going to have to do if we ever have it, just like we are going to have to try out Doppler radar, or just like we had to try out the GPWS system to prevent inadvertent contact with terrain—we are going to have to put a TCAS system in a line airplane, with a line crew, with a load of passengers, and fly it in the national airspace system.

There are some people apparently in the FAA in the legal department who are worried about the liability of that. If the system gives a warning and the pilot does turn and the warning proves to be false, who picks up the liability bill? We think that that is a risk that ultimately has to be run by all parties, the airline, the pilots, Government, the manufacturers, so forth, to get a viable system on line.

And we would encourage that system to proceed with all due dispatch. One thing we have not had in our scenario of aviation accidents this year is a midair collision—yet. And we would hope not to be back to your committee in a couple of months talking about a midair collision.

Believe me, I fly the system every day and every month, and it is a threat. There is a threat in the system, and there is a fix, we think, to that threat. So we would like to see it expedited.

Thank you.

Senator **Kassebaum**. Mr. Fleming, I read with great interest the comment in this morning's paper in which ATA has suggested that you might be recommending a quasi-private air traffic control system. Is that correct?

Mr. **Fleming**. Madam Chairman, might I add a few words to Captain McNair's statement about TCAS and then go on to the matter that you just raised?

I agree generally with Captain McNair's statement. There is not universal agreement, however, that TCAS 3 will be required as opposed to the capability represented by the TCAS 2. But through the test program he alluded to, we will find the answer in due course.

However, I would like to add that in order for that system to work effectively, we are going to have to have altitude encoding transponders in the airplanes which represent the collision threat. Admiral Engen referenced that. As a matter of fact, in Captain McNair's prepared statement, he referenced an ALPA proposal for altitude encoding transponders, and I too mentioned that we are going to have to have a regulatory requirement for that equipment, and that will become a very important matter in the future.

Now, if I might proceed on with the question you asked, by word of explanation, the ATA board of directors earlier this year asked the ATA staff to conduct an exploratory study of possible modifications in the way the air traffic control system is currently funded and operated. The ATA staff examined alternative approaches, and the ATA board of directors at their September 19 meeting agreed with the preliminary staff conclusion, and I emphasize preliminary staff conclusion, that a Federal corporation approach could hold the promise of achieving the objective of an improved air traffic and airport system.

Now, I might add briefly that what we were trying to accomplish with this study was to examine the possibility and feasibility of alternative methods for providing a more businesslike operation of the airways system as well as a more certain basis for both airport and airway system financing. And, of course, the current authorization expires in 1987.

And in connection with congressional examination of reauthorization legislation, we felt it would be timely to look at alternatives. So some alternatives have been explored, and as I say, the

Federal corporation approach appears to hold the promise of achieving that objective.

Senator **Kassebaum**. This would be sort of like the Post Office?

Mr. **Fleming**. I am not an expert in Federal corporation——

Senator **Kassebaum**. Nobody is.

Mr. **Fleming** [continuing]. Federal corporation concepts, but I would mention that the Post Office is one. There are some others that could be used as examples, the Federal Deposit Insurance Corporation, for example, comes to mind. There are a number of different ways, as I am sure you know better than I, that Federal corporations can be constructed.

And if this were to be done, the Congress in its wisdom would decide exactly what form and shape it should take.

Senator **Kassebaum**. Does anybody else on the panel have other comments to make?

[No response.]

Senator **Kassebaum**. I very much appreciate your patience in waiting to testify, and being willing to participate in this panel discussion. Thank you very much.

Now we will go back to the wind shear panel.

[Pause.]

Senator **Kassebaum**. I hope we are not slowly losing our panels.

It is a pleasure to welcome the panel; I know some of you had time difficulties in making this adjustment. It is a pleasure to welcome Neal Blake, Deputy Assistant Administrator for Engineering, FAA; William Laynor, Department Director, Bureau of Technology, NTSB; Arthur Shantz, Assignment Manager, General Accounting Office; Captain McNair, again, with ALPA; John McCarthy, manager of Research Applications Program, National Center for Atmospheric Research.

Mr. McCarthy, why don't we start with you?

STATEMENTS OF JOHN McCARTHY, MANAGER, RESEARCH APPLICATIONS PROGRAM, NATIONAL CENTER FOR ATMOSPHERIC RESEARCH; LOU McNAIR, EXECUTIVE CENTRAL AIR SAFETY CHAIRMAN, AIR LINE PILOTS ASSOCIATION; NEAL BLAKE, DEPUTY ASSISTANT ADMINISTRATOR FOR ENGINEERING, FEDERAL AVIATION ADMINISTRATION; WILLIAM G. LAYNOR, DEPARTMENT DIRECTOR, BUREAU OF TECHNOLOGY, NATIONAL TRANSPORTATION SAFETY BOARD; AND ARTHUR A. SHANTZ, ASSIGNMENT MANAGER, GENERAL ACCOUNTING OFFICE, ACCOMPANIED BY VIRGIL N. SCHROEDER, EVALUATOR-IN-CHARGE

Mr. **McCarthy**. Thank you very much, Madam Chairman. I would like permission to paraphrase my remarks for the purpose of saving some time.

Earlier, there was a request for some technical information regarding the status of terminal Doppler radar successes, let us say. I would like your permission to enter into the record some very recent materials in that regard.

Senator **Kassebaum**. Fine. We would appreciate it. Without objection, that will be made a part of the record.

Mr. McCARTHY. I would like to start by saying the very obvious, that microburst low-altitude wind shear is indeed the very serious hazard that has been made aware to the American public very recently. Unfortunately, from the research projects that we have conducted, we have found that microburst wind shear is indeed is more common than we had once imagined.

However, it is still a relatively infrequent event, but frequent enough to warrant, in my view, very major action on the part of the Federal Government. When I say Federal Government, I should also include the entire aviation system.

I will add also that the average wind shear, or head wind loss that can occur, the average value that we have measured in most of our research projects is sufficient to cause a jet transport to crash, and in fact the Pan Am wind shear at New Orleans was in fact just an average shear, from the studies that we have conducted.

Unfortunately, there are many shears in my view that are so severe that they in fact cannot be penetrated at all, although proper pilot training can make a big difference, should an aircraft inadvertently encounter a low-altitude wind shear.

Because many microbursts cannot be successfully flown, it is vital that detection systems be instituted that work, and the use of those detection systems should address the fundamental issue of avoidance of low-altitude wind shear.

Work at Denver and at Memphis has demonstrated most of the technology. Comments have been made to this effect already today. In my view, Senator Gore is right on the mark in his comments to the committee. The technology is at a stage that tells me to go ahead on a dual track, which is procurement of Doppler technology, simultaneous to continuation of the already rather successful software testing that has been occurring both at my organization and at MIT Lincoln Lab which is conducting the work at Memphis.

In my view, the GAO is too conservative in its statement that was made this morning. The risk of technology failure is far surpassed by the risk of more wind shear accidents, and I do not think that we can afford to have these kinds of accidents when the technology really is at hand.

Finally, the terminal Doppler weather radar is essentially Nexrad technology, the national network technology, with only minor variations. The GAO made a comment that it is in fact fundamentally different. In terms of a sensing technology, it is very much the same, although there have to be some variations.

We have really done most of the homework with regard to that technology in this long process of getting Nexrad national network on line, and it is, in fact, only minor engineering details and the software issues that have to be completed before that system is ready to go.

Now, I want to address what I believe to be a six-step program which can successfully mitigate the low-altitude wind shear hazard. And it is not only Federal Government. It has to be in concert with the entire aviation system. That is, industry, academia, and Government institutions.

We must undertake steps to improve in-depth education and training of pilots and controllers to deal with this issue. And in my view, that is the glue that holds many of the pieces together. You must have an in-depth training program.

In this regard, I have been associated with an aviation industry-wide unsolicited proposal to the FAA, led by the Boeing Co., to establish a universal wind shear pilot training course, and I am sad to say that that program is yet to be approved. It is a simple, straightforward approach to the problem that has been tested on the firing line last summer at Denver for a United plane that didn't crash, I think partially because of that training program. We must get on with that job. But it is in trouble today, as I see it. I hope that I am wrong on that.

The important part of that program is that it is endorsed by a broad segment of the industry, both within and outside Government. The low-level wind shear alert system has been spoken of. The system, as has been spoken, is not fully adequate for the microburst job at this time and never will be completely adequate.

It is not nearly as adequate as Doppler radar, but the system can be improved quickly and relatively easily, and some of that work has already been done, but not implemented except at two places. In New Orleans and in Denver, the FAA has doubled the number of sensors, and additional work continues in that area.

That improved system can be implemented several years in advance of a Doppler system, should the Government decide to proceed. We do need, however, to complete the terminal Doppler radar system. It not only mitigates the low-altitude wind shear hazard but it has some major efficiency issues. We found, for example, in our test at Denver that a simple calculation showed almost $1 million of gasoline savings in simple use of weather hazards to improve the efficiency of the airport.

Now, this parallel track of procurement of that radar software suggests we continue the demonstration of the software. Like at Memphis, it is suggested or it is likely that that demonstration will be at Huntsville for a research program next summer and perhaps at Denver in 1987. The procurement cycle will take until 1989 or so to get those radars on line. I am confident that the software issues are tractable in that time frame.

Finally, a couple of points quickly. There is some work to be done in demonstrating on-board Doppler radar techniques, but it is 5 to 10 years away before that technology will be demonstrated. There should be some R&D funds spent in that direction so that the radar goes wherever the commercial jet flies.

And last, but certainly not least, the Nexrad network must be implemented for en route needs. As has been clearly stated, it does not address explicitly the small-time space scale associated with the airport terminal. It is critical to note that there is not a single solution. We cannot put all of our eggs in one basket here. We have got to address all of these issues, some of them now, some of them later, to get the problem fully solved. I don't think we can ever eliminate wind shear accidents, but we can make them instead of every 1 or 2 years maybe every 20 years or 30 years if we are lucky.

I want to make one final point, and that is, the FAA is in the final stages of putting together an integrated wind shear plan that addresses all of these issues. This is a consequence of putting a focus on wind shear in the agency, a focus on weather. I have had the honor to participate in that process, as have many people here in this room industrywide to help focus the FAA's planned roadmap to get on with this job.

We need to get on with it. I want to see the job finished. And that is, Madam Chairman, why I am here, and I will be happy to answer any questions.

[The statement follows:]

STATEMENT OF JOHN MCCARTHY, NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

My name is John McCarthy, and I am manager of the Research Applications Program at the National Center for Atmospheric Research in Boulder, Colorado. NCAR is operated by the University Corporation for Atmospheric Research, a nonprofit corporation sponsored by the National Science Foundation. While NSF funds the majority of the research conducted at NCAR, the Federal Aviation Administration funds most of my research. I direct wind shear research at NCAR, where I have directed the NCAR portion of the Joint Airport Weather Studies Project, known as JAWS, and directed the Classify, Locate and Avoid Wind Shear Project, known as CLAWS. I also chair the Aviation Weather Forecasting Task Force, which addresses short-term technical improvements in the aviation forecast system of the federal government.

I am pleased to respond to your invitation to testify, regarding aviation weather hazards, particularly with regard to the nature of low-altitude wind shear, and the means to successfully detect and warn of this most serious hazard.

During the next few minutes, I would like to discuss several topics:

1. Recent information regarding the magnitude, frequency, and danger to aviation.
2. Recent experience using Doppler radar to protect airport terminals.
3. New directions for improving the Low-Level Wind Shear Alert System (known as LLWAS).
4. Some general comments on finding and implementing an in-depth solution to the low-altitude wind shear problem.

A series of lecture slides will be shown here.

In summary, I believe that a six-step program to successfully mitigate the low-altitude wind shear hazard should be undertaken by the federal government, in concert with the entire aviation community. This effort should be composed of the following components:

Undertake steps to provide in-depth education and training of controllers and pilots about the hazards of low-altitude wind shear, including the critical need to avoid the hazard, with the recognition that there are some shears no aircraft can successfully penetrate. At the same time, these training steps should include the teaching of piloting procedures that substantially improve the chances of a successful aircraft penetration, should a wind shear be inadvertently encountered.

Improve the LLWAS by increasing the resolution of the system by placing more sensors at a higher density, by implementing improved computer software calculation techniques for better detection of wind shear hazards, and by improving air traffic control tower displays to provide a more useful presentation to controllers.

Complete the development and implementation of airport terminal Doppler radars at major airports, nationwide, for the detection and warning of low-altitude wind shear, while at the same time provide weather hazard products that not only improve safety, but provide for a more efficient and hence a less costly airport operation.

Develop operational demonstration facilities for the testing of new sensors technologies, including the development of semi- and full automation, and stressing controller and pilot usable products; these products must be sufficiently quantitative to allow for safe operating decisions to be made.

Proceed toward the development of a commercially viable airborne Doppler radar that can detect wind shear, for on-board direction and warning in remote areas where ground-based terminal Doppler radars will not exist.

Continue with all deliberate speed to implement the NEXRAD Doppler radar network, to obtain regional severe weather aviation advisories that alert pilots and controllers of conditions that are ripe for airport hazards.

It is critical to note that there is no single solution to the low-altitude wind shear problem. Any single item that I have indicated above cannot solve the problem. In my view, all of these steps are necessary to fully mitigate the hazard.

I think you for your allowing me this opportunity to address you, and I will be happy to answer any questions that you may have.

Senator **Kassebaum**. Thank you, Mr. McCarthy.

Captain McNair, did you have anything that you wanted to say?

Mr. **McNair**. Yes, Madam Chairman, I have a short statement I would like to read.

My association and the over 34,000 pilots we represent, all of whom have a significant interest in the subject of wind shear, severe weather, in particular wind shear in the microburst greatly affects those of us who fly as a profession.

We are extremely interested in any legitimate proposals that might offer a solution to this problem. Before proceeding with our comments on proposed solutions to wind shear detection, I would like to discuss the subject of wind shear itself.

First, it is very important that we distinguish between wind shear and a microburst. A microburst, which is wind shear in its most severe form, should be separated from other forms of wind shear. To call a microburst wind shear is to call a hurricane gusty winds.

A microburst is a phenomenon that cannot be flown through successfully and must be avoided, and if I might add, Madam Chairman, no amount of training will change that fact.

Second, we must realize that we still do not know the full nature of microbursts, and therefore cannot legitimately argue for any particular recovery technique once an aircraft penetrates a microburst. Much analytical research is needed in this regard, for until we develop failsafe detection techniques, pilots, controllers, and others in aviation must know what they are up against and how best to react to it.

Research on microbursts and their development is currently under way as well as analytical research on optimal aircraft trajectories in microbursts. This work must be funded and allowed to continue.

Much has been said about the next generation radar technology, Nexrad in its application to aviation weather, and we fully support this worthwhile program. It must be understood, however, that Nexrad as presently defined fulfills only part of the need of the aviation user. The new technologies it brings to weather surveillance such as Doppler radar. Although a significant improvement over the existing weather service radar system, are limited to the en route struture of aviation.

If we hope to use this technology to detect wind shears and microbursts, it must also be able to perform in the terminal environment where these hazards are the most dangerous.

The obvious vehicle for such an application is the terminal Doppler radar, and we ask that this program receive your full support as well. Terminal Doppler radar is a necessary extension of Nexrad technologies if we hope to mitigate the dangers of wind shear and microburst in the aviation community.

It must receive the same priority as the overall Nexrad Program. At its current level of development, however, we are not yet convinced if the Doppler technique will be able to provide consistent and reliable detection capabilities in the dynamic environment of terminal operation. We consequently endorse an intensive and accelerated research program and further development of application techniques focused on the terminal Doppler radar system.

Likewise, we ask that concurrent funding be made available for an equally aggressive program for research and development of airborne sensors capable of detecting wind shears in the immediate vicinity of an aircraft. In this way, state of the art detection capabilities will not be limited to select airports, and we will provide the public with the highest possible level of safety.

Various promising technologies are under development for such equipment, and these activities should be continued.

Finally, Madam Chairman, any solution to the wind shear problem will rely heavily on how effective we are in passing weather information to the pilot. This issue has been addressed many times before, yet we continue to have accidents where the lack of timely weather dissemination was a factor.

The industry is guilty of underutilizing even the present weather radar system, and is horribly inefficient in dissemination techniques. All of the data in the world cannot help the pilot if he receives it too late.

I would like to take just a second to expand on that. What we are saying is that there are employees of the United States who have vital weather safety information that should be made available to the pilots. Because of interdepartmental lack of coordination, that information is not being made available, and we specifically cite employees of the Department of Commerce and those of the Department of Defense.

Madam Chairperson, there have been several statements made earlier in this hearing concerning the number of wind shear accidents that have occurred over the past several years. For your information and for the use of the committee staff, we would like to submit for the record a list of wind shear accidents which is contained in a report on a special study conducted by the National Academy of Science on the subject of wind shear.

In addition to this testimony, we also are submitting a statement regarding FAA aircraft inspectors, which we understand is another concern of this subcommittee. Obviously as flight crew members, we have an inherent interest in aircraft inspections and the quantity and quality of inspectors to carry out this program.

Our interest has intensified as the number of operators has increased by 122 percent while the number of inspectors has decreased by 27 percent.

I thank you for this opportunity to speak with you today and provide our comments. I will be responsive to questions. Thank you.

Senator KASSEBAUM. Captain McNair, let me ask you, how many pilots have had training in flying in wind shear?

Mr. McNAIR. To the best of my knowledge, on the carrier I work for, all of us have had training on wind shear at one time or another. It may not have been in the particular airplane that we are flying now. In any case it would have been in a simulator. You don't do wind shear training in the airplane. I have had wind shear training and I happen to work for the same carrier that had the accident at DFW. I have had the training in the simulator for all the types of airplanes that I have flown.

Now, let me say this to you. I am somewhat doubtful as to how effective that training is, because I have some real problems with wind shears that I have encountered in the real world versus wind shears that are programmed in the simulator. Keep in mind that the wind shear in the simulator is no better than the programmer, and I am a little concerned about the effectiveness of the training.

I am also worried about the possible negative aspects of that training, in that we ought to teach people to avoid and not to fly through them.

Senator **KASSEBAUM**. You are nodding, Mr. McCarthy. Do you concur with that? You mentioned the Pilot Training Program. Was that a simulator program that you were talking about?

Mr. **MCCARTHY**. Simulator aspects are one part of it. Up front in that program is avoid, avoid, avoid. Avoid whenever possible. The problem is that without sophisticated technology to detect, unfortunately, pilots find themselves in wind shears. We have to maximize their chance of getting out should they inadvertently get into a wind shear. Absolutely avoid it when you can, but without Doppler or sophisticated technology, the record clearly shows we cannot do that.

Senator **KASSEBAUM**. It is my understanding that Stapleton in Denver where they were testing part of the terminal Doppler system——

Mr. **MCCARTHY**. Yes.

Senator **KASSEBAUM** [continuing]. That a pilot approached with that information available because of the Doppler system. He has said that it saved his life, but he apparently went ahead and landed anyway.

Mr. **MCCARTHY**. Yes.

Senator **KASSEBAUM**. I would like to have your reaction as well as Captain McNair and ALPA on this. Obviously this is the pilot's decision. If he had been doing what we have all been saying he should do, he wouldn't have gone in.

Mr. **MCCARTHY**. Your point is well taken. We do not know in detail what happened to the airplane per se, because it is an anonyous process to get that information to us. The pilot did in fact get an advisory based on Doppler radar from us through air traffic control; did go ahead and land. The presumption is that he substantially increased his approach to get it on the runway, and claimed that that awareness saved his airplane.

Now, it is true you have to go, you have to look very hard at the issue of going some place else and holding for a while or trying to get through one. My preferred view personally is to not continue your approach when you are aware of a microburst wind shear being present. So I certainly agree with Mr. McNair, and I think that we have to pursue that. But on the other hand we have to be able to deal with the inadvertent encounter more successfully in the training program, which includes simulator training.

Senator **KASSEBAUM**. It would seem to me that pilots have a big responsibility here, and perhaps ALPA shares the responsibility of developing procedures that can provide better guidance.

Mr. **McNair**. That is correct, Madam Chairman. We are doing that. In fact, I think one of the most comprehensive wind shear symposiums ever held in this city was held by ALPA back in 1978, when we had 2½ days on wind shear and we have forecast a number of the things that have since come true. Let me speak to this directly.

And I think what you are talking about, and we have been going around the issue, is who is going to shut down the airport, and that is the real issue.

First of all, the airport operator, the person who—the governing board and so forth of the airport—they don't want that responsibility, and they shouldn't have that responsibility because they don't have the technical knowledge. Should the FAA have the responsibility? Yes, in this way; that when our Doppler radar techniques and even present technology using weather bureau radar indicates that a storm is within a certain distance of an airport, and that technology is available today, it could be prohibited by regulation that anybody would take off or land. That is a possibility.

In one of those 36 recommendations from the NTSB to the FAA, one of the ones not acted upon yet, the NTSB recommended that to the FAA. Now, we do that in other forms of hazards to aviation, and let me cite two, fog first, that when it gets too foggy, we stop landing and taking off. Does the FAA really close the airport? Not really. The FAA tells the pilot what the RVR, runway visual range measurement is, the pilot consults his approach plate, and finds that that is below minimums and does not take off or land, by regulation.

We do it in another area. That is snow in airports. After some accidents in the early years of jets, we found out that jet aircraft should not operate in more than a half-inch of wet snow. So that is prohibited. What that makes the operator do is go out and plow the snow and get the airport clear so that people can operate.

Is there possibly an interim regulatory approach? There is a possibility of that, and it ought to be looked at based on current technology. Now, is this going to require a better flow of information from the Department of Commerce to the Department of Transportation? Yes, better than exists today.

When someone who may be a Weather Bureau employee determines that there is a level 3 or 4 or 5 thunderstorm within 3 miles of an airport, it might become a first priority duty for that individual to so notify that air traffic control tower, and that air traffic control tower might have to say thunderstorm alert or microburst alert or the possibility of a microburst exists, therefore we are not going to operate off the runway until that thunderstorm moves *x* miles from the field.

There are a lot of numbers to be put in there, what level of thunderstorm, what is *x* miles, and so forth, but does that have potential? Yes, that has potential certainly as an interim measure.

Senator **Kassebaum**. Mr. Blake, do you have any comments to make on behalf of FAA.

Mr. **Blake**. Thank you, Madam Chairman.

I think the testimony of the other people has pretty much indicated to you the broad base of our Research and Development Program, and includes the training that you heard about, and the publication of information on any airborne guidance systems that might help pilots fly through them.

I would strongly underline the statement that has been made that there are a number of microbursts that the pilot cannot fly through, and since a lot of the effort and emphasis has gone into detection devices, we are much farther ahead in the ground system. With regard to the ground terminal Doppler weather radar, we think it is ready to proceed, and I think you have heard others support that view.

We are also working with NASA with a view toward improving airborne Doppler weather radar, realizing that it will never see all of the microbursts, but we want to see what we can do with the airborne unit to enhance its capability, but that is a research program, and the results will not occur until probably the early 1990's.

And with that, I would be happy to answer any specific questions you might have.

Senator KASSEBAUM. It is my understanding that immediately prior to the Dallas accident the National Weather Service had informed the tower that there were weather problems at the airport. Is that correct, Mr. Laynor? Is it also true that the controller did not pass the information along?

Mr. LAYNOR. I can't respond specifically to your question, Madam Chairman, regarding the information that was passed from the National Weather Service directly to the tower. It is my understanding that the information on a teletype in the tower indicated cumlonimbus clouds north through northeast of the airport. I would like to respond, to some of the general discussion that has been going on.

First of all, the NTSB, of course, has been advocating just about all the actions that have been described by others here and that are being taken as part of the FAA's integrated wind shear plan for the last 10 years, and we are very encouraged that a lot of this activity or just about all of it is under way.

We would like to caution, however, that some programs should not take place at the expense of the progress being made in others. Starting first of all with the training aspect, the simulator training is a very big portion of the training program, but it has to be recognized that a pilot can only be exposed to so much time in a simulator during training, and he cannot be exposed to all of the conceivable wind shear conditions. Further, I agree with Captain McNair that there is some danger of negative training if he is exposed to wind shears that are easily penetratable, and if he is taught that he can indeed use certain procedures to penetrate that wind shear. There are others that he cannot penetrate.

The simulator training has to be coupled with aerodynamic training so the pilots are able to know what is happening to the airplane when they get into this particular condition. There has to be meteorological training so they know the conditions which are conducive to microbursts or even dust front type wind shears and how they should have to respond to those conditions.

For example, the low level wind shear alert system indication may not mean too much to a pilot if other conditions are not conducive to wind shear, but if there are thunderstorms at the far end of the runway or there is knowledge that there are storms in the area, it should be very meaningful to him. The low level wind shear alert system itself, there is an awful lot that can be done very quickly, in our view, to make that system a much more usable system to provide very meaningful information to the pilot.

A lot of that work is going on right now at the FAA's Tech Center, and now by Dr. McCarthy's unit out at the National Center for Atmospheric Research, but we see no reason why enhanced systems, anemometers, which are not high technology cannot be installed in certain airports starting almost immediately and why the software that would go along into making those systems into a meaningful tower display which would provide the controller with indication of wind divergence on that field could not be implemented quickly.

There is a lot of activity going on to study the climatology from information from those systems. We have been advocating for years that those systems be recorded so that we can indeed take a look after the fact to see how often you may have to suspend operations as a result of a wind shear alert. That work has to continue and has to continue very quickly.

Regarding the Dallas-Fort Worth accident, the low level wind shear alert system had not alarmed at the time that the accident occurred. This indicates again some potential shortcomings of the system which read winds in excess of 80 knots just shortly after the accident. The system has to be expanded so that it will protect an airplane when it gets at a critical altitude, which may be 500 feet.

This means going a mile and a half beyond the end of the runway with anemometers. That is going to cost money. You are going to have to buy real estate. You are going to have to do the wiring into the system, change the system software, but that effort has to be supported.

I think that pretty well sums up our views.

Senator **Kassebaum**. Mr. Shantz, GAO testfied earlier that even if the terminal Doppler radar system were in place, the system would not prevent 29 percent of wind shear accidents. Is that correct?

Mr. **Shantz**. That is a number that's generated in a Martin Marietta study for the FAA. The number is based on recorded wind shear data covering a period of 1975 to 1982 and 129 wind shear incidents. Martin Marietta then made certain assumptions with respect to the number of these incidents that would be avoidable on the basis of NTSB reports had a Doppler radar capability existed, and based upon the general category of aircraft, that is, general aviation, commercial aviation, commuter, they multiply these factors out, that is, the avoidance factors, and determine that for each of those classes of aircraft, that a proportion of accidents which would be avoidable if the Doppler radar existed.

As a result of that, the total was 29 percent of the 129 identified wind shear incidents would not have been avoidable with the Doppler weather radar. That is one of the reasons in Mr. McLure's testimony that he emphasized the importance of training. Certainly we are not going to avoid all wind shears, whatever the future technology might hold. It is unlikely that it is going to be 100 percent successful. That is probably an unrealistic expectation.

I would like to digress for just a moment and address what Dr. McCarthy referred to as parallel track development. Certainly my agency would not be in a position to predict what is or is not technically achievable next year, the year following, or 3 years after that, or 4 years, or so on. However, we have by virtue of our work seen a great number of FAA programs flounder after receiving a great deal of research emphasis. You have heard some of them discussed here this morning. There are predecessors to TCAS that go a long way back. There is a great deal of research that has been done on TCAS, a great deal of expertise that you have undoubtedly heard year after year after year. It is not unrealistic to assume the situation is analogous with terminal Doppler radar.

I would call your attention to the fact that whereas we cannot predict what technology is available in the future, and certainly cannot even offer up an informed opinion, as Dr. McCarthy, or Mr. Blake, what we can do is point to the situation that exists today that Mr. McClure mentioned, and there are six areas I want to review with you which we offer as our preliminary findings on the situation that exists today.

And those six areas are the Nexrad and terminal Doppler radar differ in their technical requirements, that the solutions to the technical requirements for terminal Doppler radar depend on further research and development. These are conservative statements. We are not out on a limb.

Third, that adequate national data on wind shear frequency are not available to establish siting priorities. Where are you going to put them?

Fourth, that FAA's planned efforts to expedite terminal Doppler radar procurement do not include time to test and evaluate initial production units as opposed to the research radar. The research at Memphis is an S band radar. The proposed terminal Doppler is a C band radar. Are they the same? They have three critically different characteristics. The update data of a terminal Doppler radar will have to be different. It will have to be fully automated. You have heard that spoken of. Apparently that is no easy task. The administrator told us this morning the technology is not there yet.

Fifth, although siting criteria based on traffic levels and frequency data may suggest a broadly based system as being highly beneficial, the benefit/cost data we have seen by FAA's contractor suggested very few locations would qualify on the basis of safety benefits; of the 118 sites examined, less than 15.

Senator KASSEBAUM. Why? What criteria is being brought to site selection?

Mr. SHANTZ. The benefits you mean?

Senator KASSEBAUM. Yes.

Mr. SHANTZ. Safety benefits. The entire study had to do, it was based on the historic data of 129 wind shear accidents.

Senator KASSEBAUM. Not necessarily the size of the airport.

Mr. SHANTZ. No, but frequency is very large when you get into the efficiency benefits of the system, the number of flights, number of passengers and so forth. Obviously, you would want to cover your heavy areas, even if the probability is somewhat less.

And the sixth thing concerned the interim measures, which I really think Bud has really addressed quite adequately. There are a lot of things that might be done in the interim, irrespective to the success of this research and whether it comes on line in 1990, 1992, 1989, or 1997.

Thank you.

Senator **Kassebaum**. Thank you. I am certainly no expert. Mr. McCarthy I would like you to answer that based on your experiences. I would hope that this will round out the discussion of wind shear, unless there are other questions.

Mr. **McCarthy**. I would like to take a stab at a couple of these points that Mr. Shantz has made. I think that it is a technical debate that we could have—not here—regarding the differences between Nexrad Doppler radar and terminal Doppler radar. There are some differences. But fundamentally, the best way to describe those differences really are minor.

The issue of ground quota suppression has been raised. In my view, I have recently gone to Memphis and seen the suppression of ground quota working successfully at the MIT radar.

There is the issue of the optimal wavelength. We work with both an S and a C band radar at NCAR in Boulder and throughout the United States with those radars. We view the difference between S and C as a relatively minor and easily tractable issue. There are differences. I am the first to admit them. But I consider them engineeringly minor and Mr. Shantz does not, and that is a difference in technical view.

We have worked with these radars for many many years now. There is more development required. We are the first to admit it. It is our estimate of the situation that the successes in software automation, the successes in some of the display work that has been done as an integral part of that automation, have been sufficiently strong to warrant the parallel track. There is a technical difference. Let's face it. We have a technical difference.

I agree with the issue of adequate siting data. We have long wanted the LLWAS recorded as a means of addressing it. I fully agree with that assessment. We know only at four sites what the frequency of microbursts is, and we find at those sites that it is sufficiently frequent to be concerned.

The accident statistics show that microbursts are obviously occurring at many other places, but we don't have the frequency.

My view of a forming FAA plan—and I am sure Mr. Blake will respond to this—does include in-depth testing between now and first article production on the line in 1989 should that plan continue to evolve. So I disagree with that point, which is his No. 4.

I really cannot address the cost/benefit directly. That is not my field, except that the Martin-Marietta plan did not clearly address the efficiency benefits, the fuel savings, and the secondary and tertiary benefits of terminal Doppler radar. One of the items that I am going to submit to you is a report hot off the presses by Mr. Lloyd Stevenson of the Transportation System Center which looks at the operational viewpoint of the terminal Doppler test at Denver Stapleton Airport. And that, I think would—if we save $1 million a year at a place like Stapleton, in 3 or 4 years, without the safety issue, maybe we would pay for the radar.

So there is more work to be done in that area.

I fully agree with the interim measures.

Senator **Kassebaum**. Captain McNair.

Mr. **McNair**. Yes, I'd like to respond to this.

First of all, we totally support the recording capability on the current LLWAS system. We are losing a valuable research tool every time we put in one of these devices, because we cannot preserve in any history form, what is really going on at that airport. I don't believe, in house, we have examined the Martin Marietta study yet. We will, of course. We get back a little bit to what we unfortunately have to call tombstone safety. How many people are you willing to let die before you put in an improvement?

And I am sorry your colleague from West Virginia is not here. I can cite just an example in his own State. I worked a very tragic accident a number of years ago, involving the Marshall University football team in Huntington, WV, a charter flight. That airplane collided with a hill, short of the airport. There was no electronic glide slope at that airport, and when FAA was asked about that subsequent to the accident, they said there is no economic benefit. Because of the hill, you could not achieve lower minimums by putting in a glide slope. But if there had been a glide slope, there would probably have been no accident.

Now, subsequent to that accident, there is now an electronic glide slope at Huntington, WV, and the minimums are no lower. There is no economic benefit, but maybe we have prevented several accidents.

So that is the way Government has to look at things, that all of its citizens should be precious to it, and it should be willing to spend money sometime when there is not a direct cost/benefit analysis.

Senator **Kassebaum**. Mr. Blake.

Mr. **Blake**. Well, Madam Chairman, I would like to make several comments.

With regard to the low level wind shear alerting system that is in at 70 locations and going in at 110, we will be following that with an enhancement program to increase the number of sensors. The exact number will be determined out of the tests that are going on now at the two sites that have been upgraded.

As a part of that program, we expect to change the manner in which the information is displayed to the controller, who relays it to the pilot. We are looking at several different methods; one which will identify areas of convergence and divergence, the gust fronts and the miroburst phenomena. Another one that would provide the wind shear along the runway and across the runway for the runway of departure or arrival for each of the flights departing from or inbound to that airport. And this would put the information in a much more meaningful format, than the way that we currently disseminate it.

Another part of that same program is to implement recorders. We have really two types of recordings. One is for legal purposes, where the information is recorded on the tower voice tapes. The new recorders will give us full event recording capability, which will then be available for data analysis. And that is all part of the enhancement program that we have planned.

With regard to the development in the Doppler area, I think a little bit of an aura of this as something that has happened in the last couple of years has come out of some of the testimony. I started funding the work at National Severe Storms Laboratory in the early 1970's, and we had some military pilots flying heavily armored aircraft that actually penetrated the storms that were looked at by two Doppler weather radars, to give us early information that allowed us to correlate what we saw in the way of doppler returns, and what the pilot saw flying through that storm. So we are not starting from scratch.

It was the late 1970's that we got together with Defense and Commerce and started the Nexrad Program, and the radar that we see meeting our terminal requirements would draw on that technology and be a derivative of it. We think we are ready to go ahead and acquire the hardware.

With regard to the software for both the Nexrad Program and the terminal Doppler weather radar program, the Government is providing the software. We are developing the algorithms. We are testing them. Some of that testing is being done in Norman, OK, and the results of those developments and tests will be supplied to the contractors that will code the algorithms and put them in equipment.

Now, as a test bed where, we are doing work in the terminal area, we have established Memphis. We have been doing the technical parameter determination this year—where we should locate the radar, what the scan rate should be. We have a team of experts together, which includes John, sitting on my left, that will be putting together the software that will be tested at Huntsville next year as a part of program MIST—and that is microbursts and severe thunderstorms. It is a joint program with the National Science Foundation. I believe all three of their radars will be there.

We will be moving our radar there, and we will also have one of the new airport surveillance radars with a weather channel there for the test.

In addition, we will have a very extensive Mesonet, a small weather station network in that airport area which will give us validation that the radar in fact saw all of the meteorological events that occurred.

At the end of that year, we will take the automatic detection and warning algorithms and probably go back to Denver for another CLAWS 2, if you will, for classify, locate, and avoid wind shear test, similar to the one that was run in 1984.

At the conclusion of that test, we will have the basic microburst and gust front software completed and ready for implementation. We will be adding additional severe weather detection capabilities to those radars in later upgrade packages, which could include things, some of the precursors that were mentioned, of microbursts, as well as detection and warning of other severe weather occurring in the terminal area.

Some of the software will be a derivative of that already developed for the Nexrad; the gust front algorithm, for example, is one that exists. It will be tuned, if you will, to the higher data information rate that will occur in the terminal area.

The one algorithm that is perhaps unique and different and new will be the microburst algorithm, and the definition work for that one is currently underway at Memphis.

So I think, that while we have not finished all of the software work, we know how to do it, and we are proceeding with defining the algorithms and we are going to test them next year. So I feel very comfortable that we will be able to, or would be in a position to bring these capabilities up in the 1988, 1989 time period.

Yes, there are some technical differences between the terminal and en route systems. We may choose to move the feet for the antenna down to the bottom of the antenna to improve the side lobe situation. We may not scan nearly to the range we do in the en route case. But basically it is the same machine, and the capacity, the processing capacity that is available for en route is quite adequate for the terminal.

So far as testing, that was brought up. We think we can do most of the testing including the operational testing using the Memphis equipment. Obviously, we will take the first article of any new system out and test it and that will not only be technical tests, but operational tests. So there will be a full test program, once we have the actual equipment.

So far as the cost/benefit analysis, we have continued to work with the National Weather Service on where thunderstorms occur, where the most likely sites are for wind shear occurrence, and thunderstorm occurrence, and we have matched that with the traffic at our various airports, and we see several types of benefits, and we have not claimed all of them. One of them is obviously the prevention of an accident and the loss of life, and the litigation costs that go with that.

Another is the reduction is airborne delays. And the report that John mentioned documents what we were able to achieve at Denver, with savings of—what was it——

Mr. **McCarthy**. $875,000.

Mr. **Blake**. $875,000 in 1 year. And this accrues through our ability to detect and predict when a wind shift line will cross the airport or when a microburst will occupy the approach to a runway, and to change the traffic patterns early enough that there are not slots lost, no arrival or departure slots lost.

If you take all of those benefits, we can see that the overall benefit-to-cost ratio would be 1.2 for 100 airports and about 1.15 if we went to 110 airports. And that is spreading the total benefits that accure at all airports over the total cost of implementation. So that is a program cost/benefit ratio.

If you have to qualify each site, one ends up with fewer. And we much favor the approach that results in implementation in about 100 radars, and this we think will cover the high-risk sites. We never know where the next microburst is going to bring down an airplane, and we feel we have to have at least that quantity to do an effective job of improving safety.

Thank you.

Senator **Kassebaum**. Thank you.

Are there any other comments from the panel at this point?

[No response.]

Senator **Kassebaum**. I certainly do appreciate everybody's testimony. Thank you very much.

I don't know if panel 3 is still here.

[Laughter.]

Senator **Kassebaum** [continuing]. On aircraft inspection.

[Pause.]

Senator **Kassebaum**. It is a pleasure to welcome panel 3. I again very much appreciate your patience. Just because this is the last panel does not mean that it is the least important. I think that the whole question of aircraft inspection, which has been touched on at different times this morning, is one of great concern.

It is a pleasure to welcome Mr. Broderick, Associate Administrator for Aviation Standards, the FAA; Mr. Loeb, Chief of Safety Studies, Analysis Division, Bureau of Safety Programs, NTSB; Mr. Slotsky, Evaluator-in-Charge, General Accounting Office; and Mr. Fleming who was with ATA before, and Mr. Tabrey who is senior vice president, maintenance operations, United Airlines; and Mr. Stephen, vice president, operations, Regional Airline Association.

It is a pleasure to welcome all of you. I think all of the groups have been heard from, except Mr. Stephen with the regional airlines, and. Mr. Tabrey. Do you have a statement.

STATEMENTS OF ANTHONY BRODERICK, ASSOCIATE ADMINISTRATOR FOR AVIATION STANDARDS, FEDERAL AVIATION ADMINISTRATION; BERNARD S. LOEB, CHIEF OF SAFETY STUDIES, ANALYSIS DIVISION, BUREAU OF SAFETY PROGRAMS, NATIONAL TRANSPORTATION SAFETY BOARD; JOEL L. SLOTSKY, EVALUATOR-IN-CHARGE, GENERAL ACCOUNTING OFFICE; J. ROGER FLEMING, SENIOR VICE PRESIDENT, TECHNICAL SERVICES, AIR TRANSPORT ASSOCIATION, ACCOMPANIED BY RICHARD D. TABEREY, SENIOR VICE PRESIDENT, MAINTENANCE OPERATIONS, UNITED AIRLINES; AND ALAN R. STEPHEN, VICE PRESIDENT, OPERATIONS, REGIONAL AIRLINE ASSOCIATION, ACCOMPANIED BY RICHARD COLLIE, DIRECTOR, TECHNICAL SERVICES

Mr. **Tabery**. Madam Chairman, I welcome the opportunity to briefly outline and support the basics of air carrier maintenance programs and surveillance activities to part 121 operators. We are obligated by the Federal Aviation Act to perform our services with the highest possible degree of safety in the public's interest. We accomplish this objective within the framework of a comprehensive set of FAA regulations, detailed reliability centered maintenance concepts, and the manufacturer's product support system.

The essential elements that certificated air carriers must have in place are:

First, responsibility for air-worthiness decisions must be clearly specified.

Second, maintenance and inspection programs must be in place.

Third, maintenance manuals must be in place.

They must have technically qualified personnel and a continuing analysis and surveillance program, of course, in addition to our training programs.

The need for these key elements has been demonstrated by many decades of experience and close cooperation between the airlines, the manufacturers and the Government. As a result of a cooperative effort between these parties, a maintenance program planning document was developed in the late 1960's. This document outlined the procedures and decision logic from which the first maintenance program for the Boeing 747 was developed. The latest version of this document is recognized by aviation regulatory authorities worldwide, the Armed Forces, and of course the airlines.

It specifies the broad objectives of an effective airline maintenance program as follows:

First, ensure the realization of the inherent safety and reliability levels that were originally designed into the equipment; second, to restore safety and reliability to their inherent levels when deterioration has occurred; and third, must design improvements for those items whose inherent reliability proves inadequate.

Once a new type airplane enters service the continuing analysis and surveilling system required by FAA regulations provides the intelligence needed for rational amendment to the initial maintenance program.

Thus, amendments to the maintenance program can largely be based on what the airplane is telling us. This requires an in-place organization to accumulate, analyze, and take action based on the reliability data developed during its actual operations.

Through such an organization, the content and intervals for scheduled maintenance tasks are revised either upward or downward, dictated by the equipment's need. The size and sophistication of the maintenance organization can vary widely. For example, an airline operating only one aircraft and depending largely on outside services for major maintenance, will have a relatively small organization.

On the other hand, an airline operating a large number of airplanes of several types, may find it practical to be totally self-sufficient.

An integral part and final authority for this system is FAA regulations and the FAA inspection program. These elements are vital to assure that requirements of the act are being met by holding the operator accountable and responsible.

I believe it is a sound and a proven system and has provided our industry with an enviable safety record. It did not come easy; it took time, and the combined cooperative efforts of the FAA and manufacturers to build inherently safe airplanes and the combined and cooperative efforts of the FAA manufacturers and users to regulate and maintain these airplanes to their inherent safety levels.

I believe the system fully supports the combined responsibilities of the FAA manufacturers and operators in providing the highest possible degree of safety in the public's interest. Our challenge, of course, is to continue improving the system by continuing self-examination at the operator level and surveillance by FAA inspectors who thoroughly understand the program for the operators that they monitor.

Thank you very much.

Senator KASSEBAUM. Thank you very much.

Mr. Stephen.

Mr. STEPHEN. Good afternoon.

You have my complete statement. I would like to have it made a part of the record of these hearings and just summarize that statement this afternoon.

Joining me and sitting behind me is Mr. Richard Collie, our director of technical services and a former FAA air carrier operations inspector.

I might point out that Mr. Tabery made an excellent statement. Continuous air-worthiness maintenance is required for committee aircraft seating 10 or more passengers. Although the words are slightly different between Federal Aviation Regulations part 121 and part 135, the requirements are the same almost paragraph for paragraph.

Before commenting on the specific matters of this hearing, air carrier inspection, I would like to state that safety has been the first priority of our industry and is our most important commitment to the American air traveling public. Indeed, we believe that flying continues to be fundamentally safe, and perhaps the safest it has ever been, despite the recent string of tragic accidents.

Airline deregulation imposed on FAA Aviation Standards a burden in retrospect, it was ill-prepared to handle. In that initial postderegulation period of 1979, through 1982, existing airline operations, whether by the majors, the commuters, or by the charters becoming scheduled airlines, were undergoing dramatic change. Meanwhile there was an unprecedented demand for initial FAA certification of new entrant airlines.

It was a time when the FAA was being called on to do more surveillance with less resources. And, frankly, if it had not been for the air controller's strike and a downturn in the economy in 1981, we might have experienced a little different scenario in airline safety. It certainly kept the lid on the expansion of operations for a time. Otherwise I think FAA would have faced very tough choices in assuring continued air safety.

To the credit of Secretary Dole of the Department of Transportation and of FAA Administrator Don Engen, that postderegulation situation has turned around today. A number of important steps have been taken by the FAA over the last 18 months to improve airline inspection which I would just like to review briefly.

The first step was, of course, the National Air Transportation Inspection, or NATI, in which the FAA conducted a directed inspection of all 400 commuter and jet air carriers. As the FAA went through that NATI inspection process, if it found any suspicion that there might be safety violations among these airlines, there was a followup inspection. If that followup inspection did indeed turn up violations of the FAR's, the FAA ordered immediate corrective action and as necessary issued fines and certificate action.

The Regional Airline Association wholeheartedly supported this program. Subsequent to the NATI, it became clear that FAA's inspector work force needed more resources. Last year, the Congress, with the support of our industry, voted to restore some 160 operations and maintenance positions to FAA, and recently Secretary Dole announced her intention to supplement that force by several hundred more over the next 2 years. We think these additional inspectors make sense.

It may seem somewhat odd that our airlines want more "cops on the beat." However, surveillance is as much a quality control function as it is enforcement of the Federal Aviation Regulations. Very simply, the better the surveillance, the better the overall compliance will be.

Recently, the General Accounting Office released a report that shows great discrepancy between the frequency and type of air carrier inspections being conducted by the FAA from office to office and region to region. We do not necessarily link this variation to any kind of diminished airline safety.

We do, however, believe the GAO report underscores the importance of having sufficient numbers of efficiently and effectively deployed operations, maintenance and avionics inspectors.

A second issue which has been raised this morning is the background of some of the FAA inspectors. These inspectors are classified as either "general aviation" or as "air carrier." This classification is somewhat misleading. The distinction between air carrier and general aviation inspector is somewhat artificial, reflecting the initial experience of the job applicant and the training pipeline to which he has been assigned.

Many regional and commuter airlines are surveilled by general aviation inspectors. I can assure you, however, these inspectors have been thoroughly trained on the type of operation and the equipment of the airlines to which they are assigned to inspect.

The recent series of air carrier accidents has once again heightened public concern over safety. At our board of directors meeting last week, safety was the No. 1 agenda item, as it has been at virtually every other meeting of our membership over the past few years.

I can assure you that safety is never far from my mind as well. Since January 1 of this year, I have given in excess of 140 interviews on commuter airline safety to the general press. Invariably, the effectiveness of FAA's inspection and surveillance programs is raised in the course of those interviews.

As previously stated, I believe the FAA has turned a corner. As never before, safety is being emphasized at all levels of the FAA, and indeed, in the board rooms and on the flight lines of the airlines of the United States. And, as you have heard this morning, there is a renewed commitment on the part of the FAA Administrator to beef up airline operations and maintenance inspection programs and to enforce the regulations.

However, I would like to offer one warning: In pursuing the goal of safety, it is important that we don't come up with a "new program of the month" mentality where "sizzle" is greater than substance. I might cite one example. The FAA is now testing of a program called REAP or, Record Examination Assistance Program, in which the FAA is looking at contracting with big eight accounting firms to go in and audit the maintenance and pilot and training records of airlines.

I won't go into detail about REAP right now, but to us, they seem to create more problems and have very little safety benefit. They are a waste of resources. What we want to see is a consistent application of the existing FAA inspection program. Indeed we support it fully because it has worked for many years in assuring safety.

Beyond the emphasis on consistent airline inspections, I bring to your attention that we also must step up the inspections of repair and overhaul stations which provide maintenance of props, engines, and components used on airline aircraft. Increasingly, we are relying as an industry on overhaul stations for contracted maintenance. Unfortunately, we are seeing, in the case of the regional airlines, an unexpected rate of premature failure of such hardware that I just mentioned, and I suggest that there might be a problem of quality control on the part of these repair stations.

We urge the FAA and its inspection teams to more closely monitor overhaul stations and to take action against those facilities that have poor operating performance.

Finally, the FAA is not flat-footed on safety either. As an industry association, we have had an active safety program which have included a number of training seminars over the last year which are mentioned in my testimony. I do want to mention one of these efforts that I think is a good example of FAA and industry teaming together. Coming out of the NATI inspection, it became very clear to the FAA that it had a need to standardize its maintenance inspectors in the application of what was a continuous air-worthiness maintenance program.

The FAA developed and conducted a 3-day training course for all its air carrier maintenance inspectors. Earlier this summer, we asked FAA if they would put that seminar on for industry. With the cooperation of the ATA, the Regional Airline Association sponsored nine of these 3-day training programs, and invited any airline who wanted to attend to come. One hundred and twelve airlines and approximately 360 senior airline maintenance persons participated in these training sessions.

The FAA saw a need for standardization of its employees and by working together, we have had a chance for that standardization of the industry as well. I think we are going to see real safety benefits from this in the future. We would like to see FAA mount a similar program for its operations inspectors in the future.

Thank you very much.

Senator KASSEBAUM. Thank you, Mr. Stephen.

[The statement follows:]

STATEMENT OF ALAN R. STEPHEN, VICE PRESIDENT, OPERATIONS, OF THE REGIONAL AIRLINE ASSOCIATION

I am Alan R. Stephen, Vice President of Operations for the Regional Airline Association (RAA). Joining me today is Mr. Richard Collie, our Director of Technical Services and a former FAA air carrier operations inspector. On behalf of our nation's regional and commuter airlines, we appreciate the opportunity to appear here today to discuss FAA airline inspection and surveillance practices.

Before commenting on specific matters, I would like to state that safety has always been the first priority of the airline industry and it continues to be our most important commitment to the American air travelling public. Indeed, we believe that flying is fundamentally safe, and perhaps the safest it has even been, despite the recent series of airline accidents.

It is premature, of course, to second guess at this time what the National Transportation Safety Board will find as it conducts investigations of these accidents. However, we do not believe there is any common thread that will link these tragic events, while we stand fully ready to take action in the event that a "probable cause" is linked to some regulatory or operational deficiency that is correctable.

FAA AIR CARRIER INSPECTION PROGRAMS

Airline deregulation imposed on FAA aviation standards a burden, in retrospect, it was perhaps ill-prepared to handle. In that initial post-deregulation period of

1979-1981, existing airline operations were undergoing dramatic change while there was unprecedented demand by newly formed airlines for initial FAA certification. It was a time when the FAA was being called on to do more surveillance with less resources and to choose between inspection and certification priorities. Frankly, the combined effects of the air controllers' strike and the general economy kept a lid on that expansion in air carrier operations that otherwise was leading FAA down a very difficult path.

To the credit of Secretary Dole of the Department of Transportation and to FAA Administrator Engen, the Agency has taken a series of very important steps to turn this situation around. Indeed, we believe FAA's surveillance policies are fundamentally sound.

First there was the National Air Transportation Inspection Program (NATI) in which the FAA conducted directed surveillance of all 400 commuter and jet air carriers providing scheduled service. From the initial NATI, follow-up investigations were conducted at airlines suspected of safety problems. Those inspections resulted in fines and certificate action where violations were found. We whole-heartedly supported this program.

Subsequent to the NATI it became clear that FAA's inspector work force needed more resources. Last year, the Congress with the support of our industry, voted to restore some 160 operations and maintenance positions to FAA and recently, Secretary Dole announced her attention to supplement that force by several hundred more. It may seem somewhat odd that our airlines want more "cops on the beat." However, surveillance is as much a quality control function as it is enforcement of the Federal Aviation Regulations. The better the surveillance, the better overall compliance will be.

INDUSTRY EFFORTS

As industry Association and as individual member airlines, the RAA has devoted considerable resources to safety through ongoing training programs and through providing confidential and independent safety audits to member and non-member regional and commuter airlines. During the past two years, we have conducted two flight operations workshops, one commuter maintenance seminar, a flight training seminar and shortly, a workshop on inflight safety issues for regional airline managers of cabin services will be held.

One particular program is of note. Following the NATI inspections last year, the FAA recognized a need to standardize its air carrier inspectors on the elements of "continuous airworthiness maintenance programs" by which airlines conduct their aircraft maintenance and repair. To put it simply, the NATI found that there was inconsistent application of these rules by air carrier inspectors from FAA office to FAA office and corresponding variations among air carriers. Subsequently, the FAA developed an intensive training course and sent all of its maintenance inspectors through it. This summer, the FAA offered to conduct these same clinics for industry, the last one of which was completed last week. The Regional Airline Association served as sponsor. Nine clinics were held and 112 airlines participated (360 senior maintenance and quality assurance managers).

GAO REPORT

Recently, the General Accounting Office released a report that shows great discrepancy between the frequency and type of air carrier inspections being conducted by the FAA by office and region. We do not necessarily link this variation with diminished airline safety. We do, however, believe it underscores the importance of having sufficient numbers of, and effectively deployed, operations, maintenance and avionics inspectors.

A second, related issue is the background and training of the inspectors surveilling airlines. Some are classified as "general aviation" and some as "air carrier," classifications which are perhaps misleading. The distinction between "air carrier" and "general aviation" inspector is somewhat artificial, reflecting the initial experience of the job applicant and the training pipeline to which he has been assigned. Many regional and commuter airlines are assigned to "general aviation" inspectors. However, these FAA personnel have the experience and the training appropriate to the scope of the commuter operations for which they are responsible.

RAA RECOMMENDATIONS

The recent series of air carrier accidents has once again heightened public concern over safety. At our Board of Directors meeting last week, safety was the number one agenda item, as it has been at virtually every other meeting of our membership over the past few years.

I can assure you safety is never very far from my mind. With each incident, I get calls from the new media. Indeed, since January 12, 1985, I have given in excess of 140 interviews on commuter airline safety to the general press. Invariably, the effectiveness of FAA's inspection and surveillance programs are raised in the course of these interviews.

As previously stated, I believe the FAA has turned a corner.

As never before, safety is being emphasized at all levels of the FAA and from the Board rooms to the flight lines of the airlines. As you have heard this morning, there is a renewed commitment on the part of the FAA Administrator to beef-up airline operations and maintenance inspections and to enforce the regulations. We welcome this.

However, the FAA and Congress must recognize that such efforts must be consistently applied and not evolve into a syndome in which a "safety program of the month" is announed. For example, the FAA is currently field testing "REAP"—Records Examination Assistance Program—where big eight type accounting firms would be subcontracted by the FAA to go in and examine airline operating, maintenance and training records. There are many problems associated with such an effort and the results, in our view, will have no practical safety benefit.

Beyond its emphasis on airline operating practices, the FAA must step-up its inspections of repair and overhaul stations which provide maintenance of props, engines and components used on airline aircraft. We are seeing in some cases an unexpected rate of premature failure of such hardware which suggests problems of quality control on the part of these repair stations. We urge the FAA to monitor more closely the malfunction and defect reports submitted by the airlines and to give emphasis to inspection of FAA certificated repair facilities that have poor experience.

Finally, we are urging the FAA to develop a flight operations training workshop for its inspectors and for industry to standarize application of the air carrier operating rules. From the great success of the recent maintenance seminars, this is a logical follow on effort that will prove of benefit in consistent regulatory compliance.

Thank you for your interest in the views of the Regional Airline Association. Mr. Collie and I are pleased to answer any questions you may have.

Senator **Kassebaum**. Mr. Tabery, since you are responsible for maintenance at United, I would like to have you walk through how maintenance works.

A question has been raised concerning the relationship between the maintenance inspectors and carrier personnel. How often is there an inspector rotation? Is there a standard rotation for the FAA maintenance inspectors for a region, or is there a real possibility that out of just an understanding of how everybody works, sometimes too much is taken for granted?

Does it vary by region? Does it change with carriers?

Mr. **Tabery**. That is a lot of questions, Madam Chairman. I will try to walk you through—I believe you wanted me to walk you through how maintenance works, you said, and then get into the inspector portion of it.

Senator **Kassebaum**. Well, that is the part that I would like you to explain.

Mr. **Tabery**. Maintenance works, as I described earlier, on the basis of the first document, the MRB document, which is the document representing the first maintenance plan of any new fleet of airplanes. That document is dynamic from day one. The minute the airplane starts operating, the document is subject to change.

As a carrier, air carrier, 121 carrier, we are authorized to implement changes to that program, but only in coordination with the FAA inspectors assigned to our plant or to our company. We work together to change the program and probably within 3 years after new aircraft is designed, built and in operation, you probably would not recognize too much of the original plan.

We set up the program to satisfy, if you will, our operations which is by far more practical than having a basic program that is not in tune to our operations. For example, you might operate in the environment and cold and short cycles; another operator operates in hot weather and in longer cycles, et cetera.

The inspectors work with us on a day-to-day basis—the FAA inspectors now work with us on a day-to-day basis through on-site surveillance at all times. I don't know of a day at the San Francisco plant that there is not an FAA inspector or more, two, three, four, five of them that are on duty or on the premises doing certain checking. They don't make a report each and every time they are doing on-site surveillance.

Of course, in addition, they do many other inspections, such as last 12 months, some 200—I will call them ramp inspections, if you will, places where they go to the ramp, see the airplane arrive, see how it is handled and how it is dispatched, what have you. Another 35 or 40 shop-type of inspections, where there are spot inspections and they make full detailed reports. And then there are en route inspections as well, and they vary depending upon how the FAA perceives their need to monitor our program.

Now, we at the same time are monitoring this program. We have our own quality control operation. We do not run our quality control basis on what we think the FAA might find or what they want, what have you. If they tell us they want something, of course, they are the final authority. But we have our own program and we are determined to maintain our airplanes to a safe and airworthy standard in accordance with FAR's, and the FAA really should not find anything.

If they find anything in the final resolve that is really a regulation, an FAR regulation, we failed someplace. We failed with our program.

Now, these inspectors—I have been at San Francisco for 10 years, and I have only experienced three PMI's during that time, the first one when I first got there; another one that lasted about 8 or 9 years and was promoted. He is still in the same office, and now a new one within about a year ago.

So that would give an average of three in a 10-year period, 3 or 4 years.

The inspectors themselves, I have less personally to do with. I have known many of them over the years, and they come and go, and I do not believe—and I am really guessing here—that they are there more than 3 to 5 or 6 years, but it could be that some of them do serve a much longer period.

They are very remote from us. They are objective in terms of airworthiness, but we really have, should I say, very little to do with them on any other level. They are in and out of the plant, and we both have our independent responsibilities.

I will stop there. I am not sure I am answering all of your questions.

Senator KASSEBAUM. Well, I think so. Maybe Mr. Broderick can fill in a bit, because this is a question that is raised regularly by people familiar with aviation issues.

Is there a closeness in a relationship that can develop over working together for several years, that perhaps results in your taking too much for granted? Does the FAA have national standards for rotation?

Is this of concern to the industry or to the agency?

Mr. BRODERICK. It is a good question, Madam. It is something we have to guard against all the time. In the past few years, we have had, as you know, some economic difficulties which made it difficult for individuals to pick up and move. Selling and buying houses was something that was quite a traumatic experience, financially as well as emotionally.

We now have in the FAA just established an employee relocation assistance program which should ease the financial burdens quite a bit, and we expect to be monitoring the effect that that has on the kind of turnover that we would like to see.

We do not have a national standard as such as I believe Jack Ryan mentioned earlier in testimony in the air traffic system. We do not feel it is in the employee's best interests to have an arbitrary, rigid, forcing of them from place to place. But we do encourage movement for some of the obvious reasons, as well as for employee advancement and better utilization throughout the system.

It is something that with the first year of the employee relocation program, in fact this fiscal year will be the first full year, we certainly expect to examine it. But we don't see any big problem. Every once in a while, because there are people involved in our system, we will have a people problem. But it is rare and it is dealt with swiftly.

Senator KASSEBAUM. Aren't there different interpretations of the requirements, from region to region?

Mr. BRODERICK. Yes, there are. Standardization among 1,000 or 2,000 thousand inspectors is something that is difficult to achieve, and we in headquarters, for a number of reasons, have been providing less than that of the guidance, in my opinion, in the past. Over the last 2 years, you have heard some discussion of some of the initiatives that Secretary Dole and the Administrator have embarked upon.

One of them was a safety activity functional evaluation which we did in conjunction with a contractor through the Office of Personnel Management to examine in detail every single inspection function for our field work force. From that, we learned not only what the good things were about the training programs that we have and the selection process that we have, but what some of the bad things were, and therefore how to correct it.

It is a very positive thing. We are embarking right now on the corrective actions that we will be using as quickly as we possibly can. That, coupled with the infusion of new blood with the new inspectors that we will be hiring over the next few years, gives me great optimism for a real resurgence and a positive influence on productivity and efficiency in the inspector work force, and I have to believe that is going to result in increased safety and public confidence.

Senator KASSEBAUM. The recent GAO study—and maybe Mr. Slotsky would want to comment on that—revealed that four air carriers did not receive a single FAA operations inspection in 1984. Has there been an evaluation of why that occurred? Is that normal procedure?

Mr. **Broderick**. The GAO study that Mr. Slotsky has participated in has been very helpful to us. It has been an independent audit of our independent auditing of the airlines, and it has provided a lot of useful data. The report that they have provided is in fact a compilation of that data as initially collected.

Because of the interest of the Congress, it has not gone through the normal process of discussion with FAA, correction of data, filling of holes and so on that goes on in the normal GAO report, and it is not represented otherwise. But as a result of that, we found in looking at it, a number of data anomalies, some of which is the fault of our own people where we were not able to find data that we later turned up. For example, we moved a whole office and found some anomalies there.

We have also found some airlines that are listed which never really started operation for one reason or another. For example, there was an airline that comes immediately to mind that had just part 121 operating authority granted to it, and within 2 days, because of a difficulty with the airplane, had to cease that authority. We did not have any 121 operation surveillance for that airline, for obvious reasons, and it just happened at the right time in the fiscal year.

So I think the answer to the question is that most of them are reporting anomalies for very understandable reasons, and do not represent any kind of real trap or hole that we have got in the system. Nevertheless, starting today, the process that is part of the functional evaluation has resulted in a minimum inspection standard across the country for all airlines and repair stations, as a matter of fact, and for all regions. So we will not have that kind of thing happening in the future for any reason.

We have also improved our data collection and reporting scheme so that we will not have the difficulty in supplying GAO and others with that kind of data in the future.

Senator **Kassebaum**. Mr. Slotsky.

Mr. **Slotsky**. After we issued our report, Chairman Mineta, House Subcommittee on Aviation, sent a letter to the FAA raising some of the same types of questions you have just raised about frequency and types of inspection. Recently, FAA has just responded to in a letter to Chairman Mineta.

Generally, they agree with the type of information that we presented in our report. They have made, as Mr. Broderick has mentioned, have made changes in the program to address these types of problems that are indicated by these variances in inspections.

There are several instances in there where, after we performed the review, they were able to locate some additional inspection reports at the various FAA offices to show that there may have been more inspections of some of these carriers than we had in our report. But generally, they agreed in the response with the type of information that we presented.

I would like to also address a point that was made earlier by Mr. Stephen as far as what he referred to as the "program of the month". Right now, the thing seems to be to hire more inspectors for the FAA. We at the General Accounting Office have some concerns about just hiring more inspectors. I understand what Mr.

Broderick just mentioned, that there are some ongoing programs or efforts to improve the overall inspector program.

But last year, FAA hired 166 new inspectors, or were authorized to hire 166 new inspectors. Through the work that we did in our initial study, which we published on August 2, which basically just listed types and frequencies of inspections, we spoke with a lot of inspectors out in the field. And they raised a lot of questions which have now become some of our concerns, concerning what do you do when you have a large influx of inspectors?

We spoke with inspectors who said we are not getting the training we need. FAA has hired 166 new inspectors, but no provisions have been made for the additional training.

Related concerns also address retaining the new inspectors after you hire them. How do you allocate the inspectors to the various regional offices and district offices? How do you train the inspectors? Formal training, OJT? And then also addressing the point you raised concerning rotations. In one office, I believe, there was a PMI that spent his entire career with one carrier. I think that was an 18-year career at one carrier.

You don't necessarily have to move inspectors from city to city or office to office. There is room for rotation within a particular office, particularly the larger offices. We, in the General Accounting Office, are in a very similar position as the FAA inspectors are. We are concerned about Slotsky being in Mr. Broderick's office every day during his career.

We have a rotation program in the General Accounting Office. We feel that it provides our auditors, our evaluators, with a variety of different experiences, and it also prevents what may be the appearance of an auditor, an agency, becoming too cozy.

That would also work, I believe, at the FAA and also provide a lot more experience for the inspectors.

Getting back to the system, what do you do with the inspectors once you hire them? There are questions concerning the types and frequencies of inspections. FAA has just issued a basically minimum inspection guidelines in terms of the minimum inspection requirements concerning a particular carrier.

I have some concern about that. I think that is a good first step. I think more information has to be given out to assist the inspectors than where do we go from here, now that we have done the minimum?

And finally, management feedback. How does management, FAA management in Washington, DC, find out what is going on out there in the field and how they take corrective actions based on that?

Senator **Kassebaum**. Thank you very much.

I would like to ask Dr. Loeb if NTSB, still has the concerns they have expressed in the past, has concerns about standardization and procedures to be followed. What do you think of the number of people involved and the training question?

Has NTSB done any work in this area?

Mr. **Loeb**. Madam Chairman, good questions. I would like to start out by saying, first of all, that the numbers of accidents, rates, do not right now show an alarming upward trend. I do not think that our aviation transportation system is in deep trouble. In fact, quite the contrary. I think it is still a very safe system.

We think our job at NTSB is to try to keep it that way by making recommendations after investigating accidents and doing studies, and that is what we are attempting to do. However, we are concerned, very concerned, by the recent spate of air carrier accidents. More importantly, we are concerned by the fact that a lot of what we see in the accidents that we have investigated in the last several years show evidence of the same kinds of problems that we saw throughout the 1970's.

In the early 1970's, we did a study of the air taxi industry, and produced a report in 1972. Later in the 1970's, we did a study of the commuter industry, and in 1980 issued a report and made recommendations. We have seen a number of both parts 121 and 135 accidents in the 1980's with the same kinds of problems that we saw throughout the 1970's occurred. That has given us some concern.

As a result, we are now in the process—and have been for a while—of looking at the FAA surveillance of air carriers. And I am talking about both 121 and 135. We do not, however, want to duplicate what GAO is doing and so the answer to your first question about the numbers, is that we are really relying on the GAO work in that area.

What we are doing is looking at what we found in the accident investigations and studies conducted during the 1970's and early 1980's, and the recommendations that we made to the FAA, and we are asking them to supply detailed documentation as to what action they actually took. In general, the FAA responded to most of the recommendations in a positive manner, some not so, but for the most part they did come back with a positive response.

The question is, What actually was done? What action was implemented? And indeed, more importantly, were the actions taken by the FAA evaluated for efficacy? We have asked for detailed documentation. The kinds of problems we are seeing now: inadequate record keeping on repairs, on training, on duty time, inadequate or improperly performed repairs and maintenance, weight and balance problems again in the 135 area, we saw them repeatedly throughout the 1970's.

We are concerned about job classifications and standards, inspection procedures, policies and guidelines. We want to see the detailed written documents. What does an inspector do when he does certain kinds of inspections—ramp inspections and en route inspections? What kind of paperwork do they do? The paperwork trail is probably as important as any of the issues.

You can learn a lot from flying an en route or from a ramp inspection, but I am not sure that many of the problems that we are seeing can be uncovered without doing an awful lot of detective work.

We are obviously very pleased by a lot of the things that are happening now within the FAA. The recent maintenance training program which one of my staff members attended. We are also pleased that now there is an effort to try to set minimum standards for inspection. Nevertheless, because these problems that we have seen in the past continue now we are taking a very close look at this. It is too early to report on what we are finding, but that is the status of our review.

Senator KASSEBAUM. Thank you.

Mr. Broderick, do you see any problem with the absorbing the new inspectors into the training system, and how long does it take?

Mr. BRODERICK. It only takes a few months to actually go through a particular training course. There are several training courses that each inspector, depending on his or her specialty, should take over a period of 2 or 3 years. So if you are talking about when initial productivity is reached, we would hope, if we do a decent job of scheduling the hiring and training slots, initial productivity is reached toward the end of the first year of employment, and full productivity is reached in several more years.

I do not see any problem at the current projected rate of about 150 people a year. That kind of rate we can absorb. And we are in fact welcoming the kind of attention that is being paid to helping us improve the training program because the training program in fact takes what we feel is the best raw material available and makes it into a real professional inspector that we demand in the FAA.

Senator KASSEBAUM. Mr. Stephen, I would like to ask you, because there is a difference in training, and maybe you or Mr. Broderick can speak to it—about the difference between the commuter and the commercial airline?

Mr. STEPHEN. I am sorry. Are you referring to our personnel or FAA's personnel?

Senator KASSEBAUM. No, the maintenance personnel. Isn't it the Oklahoma City Aeronautical Center that does the training for maintenance personnel?

Mr. STEPHEN. I think I should defer to Mr. Broderick.

Mr. BRODERICK. There are differences in the training. We are finding those differences less and less important as the system, the aviation system, evolves and the distinction blurs between what is a commuter and in fact what is an air carrier. They are both air carriers, a large airline, let's say.

The really important distinctions deal with the systems of small air taxis versus large airlines like United. And, incidentally, commuters can be very large complex airlines, and many of them are very sophisticated airlines. They are not small airlines, like some people have the image.

But the most important difference is expertise and understanding of the particular type of equipment, the airplane that is operated, and the kind of maintenance that is being done by the operator.

Mr. STEPHEN. I might add to what Mr. Broderick has just said. The distinction is blurred. We have this year 10 commuter airlines that will board more than 1 million passengers each. As was just pointed out, commuters can be very sophisticated operations with continuous air-worthiness maintenance program much like the majors. Obviously, there are big differences in maintenance on a 400 passenger Boeing 747 and the 15 passenger Beech 99 built in your district, Senator. The reason I raise this is that when an air carrier writes a manual, it complies with all the requirements. Yes, one is a lot more complex airplane than the other, but you are trying to achieve the same levels of dispatch reliability on same levels of utilization, regardless of aircraft size. The passenger expects you to go when you are scheduled to go, so your airplane better be maintained to the highest level of reliability, whether you are United Airlines or Air Midwest.

Thus commuter airlines have to be under the same types of maintenance systems as the major airline. That is why I said earlier, that there is only artificial distinction between FAA "air carrier" and "general aviation" inspectors. The point is to make sure that whoever is surveilling an airline has adequate training, knows what to look for, and is familiar with the type of equipment the airline is operating, both operationally and from a maintenance point of view.

Senator **Kassebaum**. Dr. Loeb.

Mr. **Loeb**. We certainly agree with Alan Stephen on that point. We think that the inspectors certainly should be well-trained, regardless of whether they are doing 121 or 135 inspections. That is one of our concerns, however. In some of the accidents we have investigated which involved regional carriers who have been flying both large aircraft and small aircraft, we have been concerned about the training and knowledge of the inspectors moving into that kind of operation from general aviation activities.

We are not yet convinced that the transition has indeed been successfully made and that the inspectors that are now handling those kinds of carriers—and they indeed are a flying sophisticated aircraft—are properly trained. We are not sure that transition has been made yet where the inspectors are adequately trained to perform their duties of surveilling of these regional and even some of the smaller carriers.

Senator **Kassebaum**. Are there any other comments?

Mr. Tabery.

Mr. **Tabery**. Yes, Madam Chairman. On the training, I heard a lot of emphasis on the technical knowledge, the technical knowhow of the equipment itself. I think that is important. It is obviously the basis. You have to understand a 747 and how it operates before you could be a good inspector.

But I consider equally important is the knowledge of how that airplane is operated and what the surveillance and control system is that the airline has in place. It is important that you go to the flight line and you find a defect, you found a defect and you get it corrected. But you have to go back further to try to figure out why that defect happened. Was it a training problem? Did you have that defect occur so often that it is a repetitive, chronic problem? Do we have the right system of detection in place to find it to begin with, so that it will not wind up down at the lower level?

I guess my point is, technical knowledge of the equipment is important, of the hardware is important. Knowledge of how the airplane is operated and what the surveillance system is telling you is equally important, and I think that is the most difficult part to train.

Most of us could learn a lot about any one airplane in 3 weeks or a month of concentrated training. It takes more to learn how that airline is operating. That is why going from one airline to another is also difficult. There is so much of that airline's operation that is a part of their maintenance program—particularly when I am speaking for 121 operators.

Senator Kassebaum. Well, I certainly do very much appreciate—did you have another comment, Mr. Broderick?

Mr. Broderick. Let me add, just to close for the record, we talked about aircraft accidents, the tragic accidents of the last summer. We have talked about wind shear and air traffic control and inspection systems.

I would like to kind of review—I had some data prepared to put some perspective on the current accident picture for you. Part 121 scheduled service, the operators of large airplanes like United, American, the carriers, have had their fourth best accident history in the last 10 years this year so far.

The nonscheduled operators had their second-best year since deregulation. Operators of small airplanes, unscheduled air taxis, have the second lowest fatality rate in their history. And commuters, that everybody is talking about and worried about since deregulation, have had a 54-percent improvement in the accident rate since last year, and this year, as of today, are running the lowest accident rate in history.

And that is really a remarkable achievement in the last few years.

Senator Kassebaum. I certainly concur. And many have commented on that fact during the course of today's hearing. Nevertheless, in summing up, I still believe that it is not so much a question of safety as it is just toughening up the system and making sure that as it expands and as experienced professionals retire, we are pulling all of our various resources together to meet those needs, whether it is in pilots, inspections, or in state-of-the-art technology. It is never easy to be really tough in monitoring of the system.

But I think we have a lot of factors in place today that really speak well to that, whether it be in the commuter industry, the commercial carriers, or on the agency side. And I think we are very fortunate to have the people in place that we do. But vigilance over these areas is essential. That is why I think a hearing like this can serve us all well. It brings to the fore the various facets of the picture that we are seeking to cover. And I very much appreciate everyone's patience.

Thank you. That concludes the hearing.

[Whereupon, at 2:50 p.m., the hearing was adjourned.]

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

Statement of Delta Air Lines, Inc.

This statement represents the position of Delta Air Lines, Inc, on federal programs to improve the detection of hazardous aviation weather. It is submitted for inclusion in the Subcommittee's hearings record of October 1, 1985 on aviation safety issues.

Delta Air Lines urges immediate and full funding of necessary research and development of the next generation technology for detection of severe weather with particular emphasis on the detection of wind shears and microbursts. Although the existing Low Level Wind Shear Alert System (LLWAS) may, if properly operated and maintained, detect wind shear and microburst occurrences within the immediate airport environment, it has not proven reliable for detection of severe weather events on approach and departure paths of active runways where low-level aircraft encounters occur such as that experienced at Dallas-Fort Worth Airport by a Delta flight on August 2, 1985. Nor does the present LLWAS system provide the timely alert and early warning necessary in many instances for aircraft to avoid encounters with severe weather events.

Equally important is the timely interpretation and dissemination of accurate weather information to cockpit crews. Information on weather conditions provided by current and next generation detection technology must be communicated in a timely manner and form that can be effectively and immediately understood by flight crews.

Delta is genuinely concerned that little or no action has been taken to implement the results of the studies conducted by the National Center for Atmospheric Research (NCAR) for the use of Terminal Doppler Radar in the early detection of severe weather disturbances such as the microburst or wind shear. Its Joint Airport Weather Studies (JAWS) program and Classify, Locate, and Avoid Wind Shear (CLAWS) project have clearly established that microburst type wind shears can be detected in a timely manner so as to avoid the operation of aircraft into these severe weather conditions.

Even with the full support of Congress, however, it will take time before a Terminal Doppler Radar system can become fully operational. Delta, therefore, urges that during the interim, existing Low Level Wind Shear Alert Systems be redesigned, operated, and maintained so as to maximize accurate weather information available to controlers and flight crews. Efforts need to be intensified to develop new video displays for LLWAS data so that the information available is more quickly and easily understood.

It is clear that during this interim period, the current LLWAS standard six anemometer configuration must be enhanced by promptly expanding existing networks of sensors. Such enhancement was accomplished at New Orleans last summer and is currently nearing completion at Denver. LLWAS must be configured and expanded in terms of the number of sensors and locations relative to the runways and their approaches so as to maximize the early detection of potentially dangerous wind shear or miscroburst conditions in the areas of the approach or departure paths of aircraft during their critical low-level phase of flight.

Delta is greatly concerned that federal budgetary restraints have resulted in less than full funding for the required research and development. This may be true particularly with regard to current development of the Next Generation Weather Radar (NEXRAD) which by utilizing Doppler technology shows significant promise for improved detection and early warning of severe weather events. Necessary and critical funding should be immediately provided through the Aviation Trust Fund, which Congress designed and established primarily to meet aviation safety needs.

Delta commends the Subcommittee for its leadership in conducting a thorough review of this vitally important issue relative to aviation safety. We are prepared to assist the Subcommittee in every possible way to implement the programs and policies detailed in this statement.

STATEMENT OF BERTIL WERJEFELT, PRESIDENT, XENEX CORP.

Madam Chairwoman, members of the committee, ladies and gentlemen: My name is Bertil Werjefelt, President of Xenex Corporation. I wish to thank the committee for the opportunity to present our views and findings concerning this very timely hearing on FAA Oversight and Aviation Safety.

I have previously provided testimony on several occasions to this Senate Aviation Committee and also for investigations conducted by committees in the House.

I want to preface my statement to you today that I am proaviation as I know many of you are. This is not a passing interest on my part. I have been fascinated and intrigued by aviation since I was a child. I have a pilots license. My underlying interest and desire is that we in this country take the necessary steps so we can have a healthy and superior aviation industry. I know members of this commitee have the same purpose in mind. In this regard, I am particularly familiar with the efforts by Senator Inouye and Senator Goldwater over recent years, as well as others here on Capitol Hill; former Congressman Levitas and Congressman Mineta, and your efforts Madam Chairwoman.

What I have to say to you today concerns FAA policy and attitudes more than esoteric technical issues. My statements may sound like very bitter medicine, major surgery, and rehabilitation for the FAA and to some extent the industry. However, I, like many others, have come to the unavoidable conclusion that the FAA is not doing its job. Worse than that, in my opinion it seems the FAA isn't showing up for work.

Having reviewed some of the actions, or lack thereof, of the FAA over the last couple of decades I'm sad to say that a most appropriate descriptive comparison of the agency is: An irresponsible, father, misdirected, ignorant and careless of the welfare of his family. The children, which is this case is the traveling public, needs a new father; the wife, i.e., the industry, needs a new mate. The father, the FAA, if it even can be restored to its old self, is in dire need of prolonged rehabilitation.

Some within the FAA will, deny that there is anything wrong, or that it has a problem—even though the problems have existed for several decades and over the most recent decade have become acute—apparently noticeable to almost all, except the FAA.

I am sure some of you wonder how I can say this. However, by the time I conclude my testimony you will agree it is difficult to find a better analogy.

What makes the situation even more disheartening are the many, many loyal and dedicated employees within the FAA (and industry) who have spent lifetimes striving to build up and provide for us a superior and safe aviation industry and a paternal Federal Agency to match. Many of these people have seen their dreams, hard work, and efforts frustrated and shattered by the careless and irresponsible behavior of the FAA.

Industry needs to receive guidance from the FAA to provide appropriate care and safety for the public (and its employees). That is why the FAA was formed. The public, in turn, is supposed to rely on this department of the government that it establishes appropriate, meaningful, well thought out, and up to date aviation safety standards so we in turn can place our life safety with confidence in the hands of industry. This confidence is rusting and crumbling. The public today is more fearful than ever of flying—for good reason. It's hard, as a matter of fact, you have to be very naive to believe FAA propaganda that flying is the safest way to travel when planes keep falling out of the sky with increasing frequency; when almost every month there is a catastrophic disaster sometimes with hundreds of people dead in each tragedy.

There are a multiplicity of problems facing the industry today. Some of them perhaps compounded by the deregulated environment in which the industry is operating. To be sure, some problems are very complex requiring considerable expertise. The problems ranging from serious deficiencies in maintenance, operations of aircraft in the airspace, to serious health and safety problems inside the aircraft cabin.

Aside from the sensational disasters which become newspaper headlines or the 6 o'clock news on TV, there has been little scrutiny of many serious health and safety problems which are telltale signs of potential disasters. Problems and deficiencies which seem purposefully hidden to create a false "no problem", "safe" and "friendly" image!

Now, let me explain how we have arrived at these conclusions and why the comparisons are justified—perhaps even charitable! No, you don't have to be an expert to understand what I'm going to say—I have limited myself to very simple understandable issues of policy and basic health and safety—you don't even have to know what makes a plane fly—all you need is ordinary intelligence, some "good old fashioned American common sense" and, believe it or not, a bit of that redblooded American spirit—respect for the "red, white, and blue"—we all know the spirit, that loyalty and morality which translates to "concern for your country and your fellow Americans". That's all you need to understand these issues!

Now, the first and most fundamental issue of aviation safety: It goes somewhat without saying that if you keep telling yourself and your audience; the public, and your employees, that flying is the safest mode of transportation, there is little incentive to improve further. However, if that's not true, there may be substantial incentive to improve safety. So is it safe to fly? Is it as the old adage says, "safer to fly than to drive"? No it's not! That's just propaganda. In fact you are 100, and this year perhaps even 1,000 times safer in any one car than in any one airplane. I'm sure you're thinking that couldn't be true because we've heard for so long that it's safer to fly than to drive. Yes we've heard if for a long time, but it's false. For instance, in September of 1983 the Los Angeles Times carried an extensive article singing praise to the safety record of aviation. The L.A. Times stated, ". . . plane accidents kill an average of 145 persons per year while automobile accidents average 132 deaths a day." It was said that air travel is about 100 times safer than traveling by car. So, how are these statistics wrong or misleading? Very simple, according to industry and FAA records we have less than 4,000 airliners in this country, probably closer to 3,000 depending on catagories included. In contrast, we have approximately 140 million cars, busses, and trucks registered. What we want to know is how safe is any one car or any one airplane? Based on FAA accident reports, a car is 100 times (this year about 1,000) safer than an airplane. How can this be when the high priests of aviation both in government and industry say the opposite? Well, the sleight of hand is revealed based on FAA's own statistics. Simple back of the envelope calculations reveal there are .03 fatalities per aircraft per year, while surprisingly only .0003 fatalities per automobile per year. This translates to one death per every 33 aircraft per year and one death per every 3300 automobiles per year. Looking at it in another way one can also ask what are the fatalities based on hours of operation? Based on industry and FAA records, the average aircraft is used about 3,000 hours per year. Again, back of the envelope calculations reveals that in aviation, based on hours of operation, there is normally one fatality every 50-80 thousands hours. This year it's much worse. Whereas for automobiles, based on merely an hour of operation per car per day there is only a fatality approximately every ¾ of a million hours.

(Fatalities associated, directly or indirectly, with the environment on board, i.e., improper operations of the life support system are not included or fully known, but could be in the thousands—as I have previously pointed out in prior congressional investigations.)

Needless to say there are many different ways to report the statistics. In all fairness, if there were as many planes as there are automobiles, or if the airplanes were used as much as the automobiles are, there would be thousands of aviation fatalities per day based on not just the current worst aviation safety record, but on the average record!

I'm suggesting to this committee and others who care to involve themselves in these matters, that the place to start is to acknowledge that you have a problem: The aviation safety record is miserable. It's probably the worst of any transport mode around. The fact that the aviation safety record is gyrating wildly up and down, from the best record to the worst in less than a year is obviously a strong indication that "something is out of control"—in need of corrective measures. In contrast, the annual highway death toll is very constant and predictable. Within a few thousand people, we kill and mame the same number year after year after year—many needlessly because of drunken drivers. It's impossible not to conclude, whether you're part of the travelling public or in the industry, that aviation safety is more chance than predictability. Recently FAA Administrator Engen stated publically that "flying is not like playing Russian Roulette". I disagree with him, I believe a lot of the public does and so do many pilots.

So why are we told it's so safe, when it isn't, why has it been taboo to speak openly and honestly about aviation safety problems? Because it supposedly "adversely affects the industry". Now that's really a nonsensical approach. How can one expect to correct problems if one denies that they exist? At some point in time regardless of the amount of rhetoric espousing how safe it is to fly, the facts finally catch up and float to the surface, which they appear to be doing now with the recent rash of tragic disasters. When you see one accident after another, you can't help but think and when you put the facts in proper perspective you draw conclusions—something is seriously wrong, the facts don't square with the rhetoric. Current efforts on the part of the FAA, not just current but past efforts, seem to be to cover up the facts instead of addressing the problems and improving the aviation safety record so it matches other modes of transportation. I submit to you that real safety improvement in the only solution which will restore the public confidence and make the public feel as safe in a plane as they now are in a car.

So, now that we know it's much safer to drive a car than to fly, what are some of the other matters that have been "covered up", that we have to begin to deal with openly, honestly, and forcefully? Well, for instance, definitions of problems. How does the FAA define an accident? Well, I'll tell you, it's not the same way we do. I believe I'm correct when I say that if a 747 lost its entire landing gear, it's possible that wouldn't be termed an accident. Once you find out what I found out—how the FAA stores and organizes its statistics, you'll be shocked. Instead of storing the information in easily retrievable and understandable defined form, occurances, for instance, where planes are returning full of smoke (from for example an electrical fire), are stored in a category called "Service Difficulty Reports" along with problems with trash shutes, leaky faucets, torn seatcovers, etc. Even the FAA's own staff can't locate some of the information. They have called me to inquire where I located the information.

I submit that being honest about a problem is the best approach. If there are problems that are of a safety nature, they should clearly be defined as such, categorized as such and followed closely. So, why are there, except for recent occurrences, so relatively few "accidents" and "incidents"? Because FAA's definition do not jive with the rest of the worlds understanding and definition of "accidents" and "incidents". If you want to find out about accidents and incidents based on normal understanding, you have to also include in your investigation the "Service Difficulty Reports" and weed out the leaky faucets, broken trash shutes, torn seat covers, and other paraphernalia to find at least some of the reported data relating to true and serious safety problems. In other words, if you are researching and investigating this area, for instance the inflight fire problem on board aircraft—don't call up the FAA and ask: How many accidents or incidents have you had involving smoke or fire on airplanes in flight? All you'll get is the tip of the iceberg. The bulk of those problems are in the "Service Difficulty Reports"—not in the "accident/incident files"!

Another example of deception if the reference to a crash of an airplane at sea. It's called an "unscheduled water landing" by some people. Or the misnomer of a "near miss" which should be a "near collision"; which leads to another area, that of collision avoidance and air traffic control.

The present system of ground based air traffic control is archaic. Instruments exist today to provide pilots the ability to observe the traffic around them, monitor it and avoid it. As a matter of fact, the technology has been around for years. Just think of it, most flights are done by instruments. It's like sitting in your car, being told to turn left and right and so on, strictly looking at your instruments. How much confidence does that give you as compared to being able to see where all other other traffic is? The approach and policy on the part of the FAA is completely upside down. If the technology exists to make flights safer, and they are obviously safer if the person flying the airplane knows what's around him, then why shouldn't it be implemented immediately?

I've personally been flying and been scared out of my wits, not because the air traffic controller calls me and tells me "traffic at 2'oclock, 3 miles". I'm grateful for the information, but when I discover that it was not 2 o'clock, 3 miles—it just missed me by 100 feet, then I'm not grateful—I'm angry. I suspect it almost showed up as a collision on his screen. So why was he really calling me, That's like this latest Delta crash. The reports I read so far indicate that the controller told the Delta pilot to go around—after he had crashed! Why would a controller do that?

Hiring more controllers is a stop gap measure doomed to fail—just like repairs to an old worn out car. When you have the money to buy a new, safer car you should do so—it's safer, costs less. FAA has the money but lacks the common sense. (I'm not advocating we get rid of controllers, but rather turn the "control" over to pilots and new technology and make controllers' jobs more of monitoring function, i.e., and effort to reduce the possibilities of human error).

One of the things you learn when you start training as a pilot is that if you run out of gas, you can't just pull off on the road and wait until somebody helps you. Rather you may be in very serious trouble. So why is it the FAA lets the industry get away with not even putting enough fuel on planes so they can run the ventilation and life support equipment at full rated capacity. I have on several occasions been told when I asked about receiving more fresh air on the plane that there isn't even enought fuel on board to do that. Does that make you wonder? Of course it does. Does that build confidence? The basics of pilot training is to have as much fuel as you can—just in case. What are the basics today? Just have enough to get you there and the minimum to go to another airport 45 minutes away—based on weather reports before you leave—the weather has been known to change! There are occasions in the past, which I'm sure some of you are aware of, where planes haven't even made it to their destination. They've had to land somewhere else because they ran put of fuel. That's a fortunate ending but it's sad testimony to the fundamentals and basics of safe flight.

Have you ever been on a 737 with 131 seating configuration? The 737 was originally designed for 115. Well I have been, and I'll never get on one again—ever, because it's like a sardine can. It was a 737 with 131 seats that went down in Manchester. There's no way people can move quickly and safely out of that densely occupied aircraft in an emergency. People in the back didn't stand a chance. Believe it or not the FAA does not have any meaningful occupancy density standards like we do. The closest indication of maximum occupancy density on an aircraft is the number of doors on the aircraft. It used to be that there should be enough doors on each aircraft to permit the evacuation of 50 people through each one. Now people are thinking about adulterating even that safety provision. Nevertheless, number of persons per aircraft door does not provide for occupancy density criteria that's really meaningful or comparative to non-aviation occupancy density standards.

Virtually any public place around, in this country and certainly most western nations, has occupancy density standards. Even statements on the walls of restaurants or meeting rooms and so on, indicating maximum number of people allowed. That's for health and safety reasons. The FAA has conveniently excused themselves from this responsibility. No, correction, not excused themselves, they have ignored the responsibility. Instead they have resurrected the original designer of the sardine can and are using him as a consultant to come up with aircraft seating arrangements, not for the purpose of health and safety in flight but rather to the discomfort, inconvenience, annoyance, and outright insult to the passengers who are paying for the industry and the FAA to be in business, let alone the associated safety hazard. I have previously pointed out that aircraft occupancy density standards exceed those anticipated for comparable non-aviation environments. In some cases it is more than 200 person per 1000 sq. ft. of floor are—far above that allowed for comparable non-aviation environments. That still isn't the whole story as you can see from the charts I have attached herewith. When volume is also considered as it is in the charts, the health and safety implications are much worse. As a matter of fact, as I explain later, the minimum comfort standards for a bomb shelter are 5-10 times better than the passenger cabin of an aircraft.

What about the health effects of sitting couped up for hours and not having proper blood circulation or for that matter even being able to get up and walk around, which is discouraged in every possible way. Moreover, the FAA encourages not to leave enough aisle room for people to get to the restrooms if they need. If the carts are out and lunch or dinner is being served, you're told to sit in your seat til it's finished. Now what kind of an approach is that to gain public confidence and support and good will. Frankly it's ridiculous and I don't know why the travelling public even puts up with it for a minute.

In this connection we can ask ourselves why is there currently an effort on route to discourage people from bringing hand luggage on board. The FAA will have a hard time convincing me that it's only for safety reasons. Although we know luggage racks collapse in accidents, the overlying reason may be so that they can sequeeze more seats in. Think about it. Why? Because so much of what the FAA has spoken about in the past has merely been smoke screens. They speak about reducing the carry on luggage yet they can't build seats that will hold up for minor impacts. They talk about their concern for passenger comfort and safety which in so many ways are just empty words. FAA can't even go to the trouble of "telling passengers what to do in the event of an inflight fire or smoke emergency". Now there's something to think about—90% of aircraft fires occur in flight. They've had inflight, fire, smoke, fume problems for 40 years or better, yet when Senator Inouye suggested they investigate the need for making announcements of this sort, i.e., telling people what do to during inflight smoke and fire emergency, after thousands of people have been asphyxiated on board aircraft, the then administrator found that there's not need for such safety announcement! It's nothing but an insult to the people who not only pay for but put their fate, trust, and life safety in this federal agency.

Senator Goldwater has asked that there be medical kits on board the airplanes, something that resembles what one could expect to find towards the end of the 20th century, that could provide some relief for illness (i.e. seizures) or in some cases even life-saving capability if there's an emergency in flight. The FAA is opposed to this. Where is their sensibility, where is the morality? How come the foreign carriers, many foreign carriers have it? I wouldn't be surprised if some of the aircraft in the third World nations have it, but we don't. The FAA has supported some feeble arguments about the liability of physicians etc. Again it's a smoke screen for "doing nothing".

After doing nothing the FAA advances the idea that when there is a medical problem inflight, on a domestic flight, they are only 20 minutes away from an airport. That's all good and fine, that's probably the case in some parts of the country. Notably the Air Canada disaster in Cincinnati—the plane was down on the ground within about 17 minutes. Sheer luck as far as I'm concerned. But try to hold your breath for 17 minutes when the cabin is full of lethal smoke or hold your breath when you're turning blue because you're choking on some food. The attitude and callousness about these serious safety problems is reprehensible—why should a doctor have to look around an aircraft, when a passenger is choking on some food, to try to find a clothes hanger that he can stick down the throat to remove the food stuff from the blocked air passage?—is this the 20th century or is it still the wild west? How can you put faith and trust in the agency when a prominent FAA official stands up and says he would't give 50 cents for having a smoke hood on a plane. I bet if he, or his wife, or children were on the Air Canada flight he would have been singing another tune! Certainly the passengers who survived to tell the horror story said they would have given anything for smoke protection—half the people on board were asphyxiated. Yet, this FAA official is on the record just as is the episode with the clothes hanger. Hard to believe isn't it? Are there the types of individuals involved in formulating FAA safety policy and procedures. Think about it—is this the type of attitude and concern we expect from our civil servants? Sounds more like "the enemy" at work.

As it is my purpose here today to provide assistance to this committee in its oversight effort with the aviation safety issue, I have included a reprint of my statement to this committee on Senate Bill 197. This highlights some, but not all, of the health and safety problems inherent to the aircraft cabins—obviously an integral part of aviation safety. Although the members of this committee are well aware of this testimony, I would encourage other researchers of these matters to carefully read the materials and put them in prespective. After you've done so I'm sure you'll be left with the incredulous feeling and wondering if the FAA is for real or they're in some hallucinatory fog of some sort. Why should the fresh air ventilation rates on an aircraft be close to the suffocation levels? Why, by current designs, are the fresh air ventilation rates a mere fraction of the minimum standards for a minimum comfortable environment in a bomb shelter with consequences that are indicative that one diseased individual can contaminate 72%, that's right 72%, of the other passengers on board. It's not as if the public isn't concerned about disease transmission these days. There are alarming situations occurring around us. Special precautions have been implemented in the military and schools against communicable diseases. Many diseases are airborne. Many emminate from body fluids of diseased individuals. When most of the moisture content in the air on board an aircraft is recirculated body moisture such as sweat and breath from occupants on board, isn't this a potentially serious health and safety problem? Of course it is particularly with some lethal diseases which are not well understood, but definitely known to harbor potentially lethal virus, fungus, or bacteria in the body fluids! Think about it.

One quick look at the charts that I have included from my Senate testimony on S1770 reveals totally abhorrent fresh air ventilation standards on board aircraft. Hidden down in the bottom of the left hand corner of the chart you'll find the fresh air ventilation rates for passenger cabins on aircraft. Compare that to the fresh air ventilation requirements for other environments including the cockpit and you'll be shocked.

Not only does it stagger the imagination, quite frankly one gets rather angry to discover that the FAA has been opposed to instructing passengers what to do in case of inflight fires, smoke, and toxic fume emergencies. There are 600 occurrencies of this type every year just with the U.S. fleet of less than 4,000 aircraft. 90% occur inflight where you can't escape. I have previously provided copies of more than 3,000 reports of this to this committee. Where did all these come from? You're right, from the Service Difficulty Reports, almost all of them.

When we're trying to obtain an overview of the safety problems we must ask ourselves: When two airlines operating the same type of aircraft, flying coast to coast, one charges a little over $100 dollars for a one way fare, another one charges a little overe $700 dollars for a one way fare—a $600 dollar difference—what's going on? Mind you, the airline charging $100 is making money and expanding by leaps and bounds. Are they forsaking safety? I doubt they are forsaking it any more than the

$700 dollar airline. So where is all this money going, if the $100 dollar airline is making money? Where are the other $600 dollars going for the other airline? Well we know that there are higher wages and some other items to contend with—but justifiable costs to the tune of 600%?—hardly. To find that at the same time airlines are pleading poverty, or that the FAA, as under administrator Helms is saying, FAA we can't afford even to properly investigate some of the safety matters, is really total nonsense. If the airlines can set their fares at a differential price of 600% and jockey them up and down, seemingly at will, by hundreds of dollars, shouldn't a small percentage be allocated to social consciousness—aviation health and safety?

What is happening to the 3 billion dollar aviation trust fund? 3 billion dollars, that's about a million dollars per aircraft in this country for health and safety improvements or, if we wanted to we could provide a one time surcharge of $10 dollars for each ticket for one year. How much would that be? An additional 3 billion dollars—that's right, with a "B". What's wrong with this approach when the FAA and industry are pleading poverty? Nothing as far as I'm concerned.

There is one caveat however. The FAA is always looking at "cost effectiveness". FAA has the power and authority to determine what the safety considerations are. Well, we already know a good many of the safety considerations. We also know the FAA in many cases doesn't even acknowledge the existence of many of them. What is cost effectiveness? Well, cost effectiveness in the view of the FAA is totally different from your and my viewpoint. I submit that it is cost effective for any traveler to temporarily pay one dollar, or even ten dollars, on a ticket for substantial improvement to his or her health and life safety when using the air transport system. It's a sum the public would gladly part with. That is the only cost effectiveness that means anything because any cost for safety is truly not a cost for industry or the FAA. We, the traveling public, are paying the price. It's our health and our safety—the industry is merely a middle man making a profit on the funds that the industry derives from the public for providing its service. So therefore, it cannot be an argument on the part of industry or the FAA that they are too poor to provide for elementary health and safety. If the industry and the FAA cannot afford to provide basic, elementary health and life safety standards, procedures, and equipment, until the expense is repaid in the form of profits from the public, then they shouldn't be in business. Not only is that common sense, but it is the law. To be certified as an air carrier "you must exercise the highest degree of safety for the passengers"—not put a price tag on passengers, deny them the right to basic safety, and then figure the cost of so many lost lives into the cost of doing business. This, believe it or not, is the attitude of the FAA! And it's on the record—appalled and disgusted? So am I. This isn't what we expect from our fellow Americans is it?

Obviously, there is a risk attached to most everything we do. It's in our nature to reduce these risks as much as possible, then for those circumstances we can not anticipate or those freak occurrences that border on the impossible we insure ourselves. However, the FAA attitude of knowing of the hazards and the potential lethal consequences—to the point where for instance smoke protection is required for pilots by law and now proposed for cabin crew as well—but hiding the hazards from the public. That is reprehensible. Not only that, what is presently provided for pilots and proposed for flight attendants is inadequate, based on experience! Can you believe it. The standards are based on making pilots survive in aircraft that flew at approximately half the speed and altitude of todays aircraft. There is little chance of survival based on that standard in current aircraft types. That has been proven by experience, over and over again! This is all in the records. FAA has known of these problems for decades!

This and other committees on Capitol Hill have been patient for too long. So has the DOT and the GAO. The DOT recently had a task force criticize FAA safety procedures in several areas, including their difficulty in formulating and carrying out actions in a timely manner. Likewise the GAO chiding the FAA for doing a spotty job in inspecting aircraft. The revolving door management at FAA has been making endless promises of improvement.

FAA has a history of "hurry up and wait". FAA usually waits until there have been accidents or a public outcry until they address some safety issues. FAA reacts ever so slowly instead of preempting. That, by any definition, leaves the crew and public with only one choice: If you want to use the air transport system, which is now an integral part of society, you must also play "Russian Roulette" and hope you don't wind up being one of the needless statistics, while waiting for the FAA to wake up, sober up, and go to work.

Even a quick review of the last few decades appears to reveal a concerted effort by FAA to obstruct the formulation of meaningful health and safety regulations!—

strong words, but supported by the record. Some efforts in FAA relating to simple but vital safety improvements have been going on for decades. Why? Every time there is an outcry the FAA pulls out the old dusty research work and tells the world "we're working on it" thereby deceiving the public and the press that something is being done and improvements are just around the corner. Soon as the noise dies down they put it back in the closet to gather dust until the next accident. To name just a few examples: Seat cushion floatation devices—several hundred thousand of them don't even work properly for the intended purpose. FAA's own research reveals this—it's been known for years. Emergency lighting, pilots smoke goggles, cabin fire extinguishing equipment, passenger smoke protection, fire safety instructions, seat covers, collision avoidance, unhealthy air for passengers, etc. etc. etc., problems they have been "Working on" for decades (some of the problems FAA has been aware of for 30-40 years!!!) a token few of which the FAA has belatedly started to "work on" again. What about aircraft structural and engine maintenance procedures. Are these receiving the same cavalier treatment? I believe the answer is yes. The recent Japan Airlines disaster where about 500 people perished is a recent example. When there aren't even enough nuts and bolts or rivets installed to keep aircraft from falling apart you surely wonder what is the policy? What are the mandated procedures? Is the public being used as guinea pigs to see how few nuts and bolts you can get away with? Was it an honest mistake? Since the industry requires a pressurized life support system to conduct it's business it seems only fundamental that this should be constructed, maintained, repaired, and operated in accordance with very strict rules and standards. In prior testimony I have pointed out that this is not what's happening today.

Even minor mistakes and problems in aviation can result in deadly disasters. We all know that one of the main functions of the FAA is to see that "minor mistakes and problems" are prevented, to avoid disasters. In my mind that means that many of the disasters over the last half dozen or so years should not have occurred had FAA been doing it's job—lost engines, defective engines, floors buckling so aircraft crash, minor inflight fires that asphyxiate plane loads of people, nuts, bolts, or rivets missing so aircraft fall apart inflight, foreign governments refusing to certify. FAA approved designs until corrected, still FAA does not make corrections until there are disasters—needless mid-air collisions, etc. etc. etc. I could go on and on. We have enough materials to write, not just one, but several books about what appears to be gross negligence, cover-ups, and hidden scandals.

I repeat what I said before—we have all been too patient for too long. Unless there is immediate forthright establishment of meaningful health and safety regulations on all these issues and many others which FAA is well aware of, I contend certain individuals within the FAA may well be subjected to court proceedings, charged with malfeasance. These are serious charges which do not permit the individuals to hide behind the FAA bureaucracy. The individuals have to face the responsibility of legal fees and guilty verdicts on their own.

That is minor compared to industry—who looks to FAA for guidance, but doesn't receive it. Yet, knowing full well that some safety critieria they operate under do not even come close to the charter under which they are certified, i.e., to demonstrate "their utmost efforts and concerns for their passengers' safety". This presents new, potentially explosive business opportunities for lawyers of even moderate caliber. The industry is abandoned by the FAA—left wide open to class action litigation. Recent lawsuits and verdicts concerning asbestos and other toxic chemicals, would pale in comparison to the potential aviation industry liabilities—i.e., for improper hazardous operation of passenger life support systems.

Safety may be very much improved if we didn't let past disasters fade away into the obscure dusty corners of memory. Remembering just a few of the recent disasters over the last ten years or so will remind us there are problems to address: Korean Airlines shot down because malfunctioning navigational equipment, Air Florida in the Potomac—too much ice on wings (the British had warned of this earlier), Air Canada Cincinnati—electrical fire, Air India, Midway Express Milwaukee, Japan Airlines—aircraft falling apart in flight, American DC-10 Chicago—lost engine buckled floor—more than 80 tragedies with more than 2,000 lives lost in this county alone. That doesn't even include this year's death toll which is approximately another 2,000!

I am sure there are a few "chip on the shoulder individuals" in the FAA who feel it's unfair to "kick em when they're down". I'm referring to the recent rash of disasters. I say that's not the case at all. The handwriting has been on the wall for decades—that is too long.

All we're telling the FAA is: We are fed up. Show the true American spirit, have some guts, face the facts, get with it, and clean up your act. What we want to see is

American quality and standards admired by the world aviation community—not contributing to ill health, declining safety, and disasters.

I'm certain that the many loyal and dedicated employees within the FAA and industry who are cognizant of these problems and want to see change, will be more apt to make themselves heard if encouraged to do so. These safety issues concern all of us. They are not partisan issues of Democratic or Republican viewpoints. Health and safety are bipartisan issues, public issues—in the very same sense that we vaccinate our children against polio, dyptheria, small pox, and influenze, etc. We do so for the protection and welfare of all of us, to make a better world—a better quality of life—providing for an up-to-date healthy and safe air transport system is just good morality and common sense—an expression of concern for family and fellow citizens. The type of concern we expect to see in the very near future from the FAA.

I am confident administrator Engen will shape up the FAA, given the proper support by President Reagan, this Committee and the rest of Congress. Rehabilitation and back to work is the name of the game.

The cost of the safety improvements which need to be accomplished are on the order of nickels and dimes per ticket per item. In other words, the cost of an individual ticket for an average trip may increase two cents for appropriate floatation devices, a fraction of a cent for appropriate emergency lighting, negligible sums for emergency instructions in case of inflight fires, a few cents for passenger toxic fume protection, 5–10 cents for appropriate fresh air ventilation, etc. etc. These are costs which the public not only expects to pay, but demands to have the right to pay and by present law is entitled to pay!!! (I'm referring to the air carrier charter).

Safety isn't just common sense and good morality—it's also good business. Improving our aging technology and grossly outdated health and safety standards in this area will create many more new jobs, untold opportunities for export revenues, and a potential bonanza for the aircraft manufacturing industry—manufacturing and selling new, up to date, state of the art aircraft to replace the aging and out-dated fleet. The airlines will also prosper because the public will gladly take to the skies when they know they're safe and friendly.

For this record, I am submitting a video to some safety improvements which are about to enter the marketplace which I believe will be of interest to this committee, the FAA, and the industry. Technology which will demonstrate to the public that new safety improvements are here and being implemented by the industry and FAA.

I thank you for the opportunity to present our views and assist this committee in its important aviation safety oversight capacity. I wish you well in your endeavors. Thank you.

STATEMENT OF BRIAN K. SULMONETTI

Mrs. Chairwoman, Members of Committee, I want to applaud you and your committee for holding these very important and timely hearings. The subject of these hearings is very near to me because my wife, Jayne Valecce Sulmonetti, died in the crash of Delta Flight 191 at the Dallas/Ft. Worth airport. One of the probable causes of this terrible tragedy was wind shear.

I urge Congress and this committee to take action regarding wind shear or microbursts. It is unfortunate that it takes a terrible accident to move us to get things done, but let us use this incident as a catalyst for improving air safety by eliminating the threat of wind shear. Let's not let my wife Jayne and 131 others die in vain; use their momory to push for action by Congress and the Administration.

My recommendations are:

1. Accelerate and increase funding for research, development, and implementation of the Doppler radar system. Do not allow this to get caught in bureaucratic red tape and budget constraints.
2. Increase funding for research on improved wind shear detection systems.
3. Improve the education of pilots and aircraft manufacturers regarding wind shear, including requiring pilots to go through wind shear simulations.
4. Improve and standardize the communication between the pilot and the air traffic controllers. This, I feel, may have been the major cause of the Delta crash; lack of correct and timely communication. Procedures and policy have to be created so that everyone knows who is in charge and what information should be relayed.
5. Improve reporting and increase funding for meteorologic research on the wind shear phenomenon. Weather reporting should be improved immediately and should be more complete and timely.
6. Support any efforts to pass legislation regarding this issue.

We may never know the true cause of the Delta crash, but we do know that it was a combination of many factors which can be dealt with so that they may never happen again. This would save countless lives. The joint study of the National Research Council entitled "Low Altitude Wind Shear and Its Hazard to Aviation" is an excellent review of the causes, history, and recommendations to avoid wind shear. It was written because of the 1983 crash of the Pan Am jet in Louisiana. However, it seems their recommendations fell on deaf ears. Most of the recommendations have not been carried out, and all of them are still needed today. I would like to have this report put into the record of this hearing.

I am not an expert witness on aviation and air safety, but I know how it feels to lose a loved one in an airplane crash. We must do something so other people don't go through what I am going through. I recently read a comment in the Washington Post by an unidentified OMB official stating that "you take all the people who died in the Delta accident. More people were killed on motorcycles last week. How safe is safe?" Well, this may be true, but one at least one has some control on a motorcycle; you are at the wheel, no one else. In an airplane, we put all our trust into the pilot, the manufacturers, and the air traffic control system. If any of that breaks down, we lose and we have no control over events, not one bit. If the public puts that much trust into flying, the government and private airlines should take all the precautions necessary for a safe flight. Including implementing the Droppler radar system and the other recommendations.

Cost is insignificant given the loss of lives, even if it were only one. However, realizing the current political climate, budget is a main concern. I suggest that Congress increase funding for air safety measures by either increasing the 8 percent surcharge on passenger tickets to 10 percent and having the increase earmarked for new radar systems (I don't think any passsenger would argue or complain!). Or, Congress could create a joint public/private effort to bring these new radar systems on line. I think the government, the airlines, the airports, the pilots' union, and airplane manufacturers could work out a very nice joint effort that would not cost the taxpayers.

Mrs. Chairwoman, I would like for my wife Jayne and others not to have lost their lives in vain. We must build and deliver this new radar system in order to eliminate the danger of wind shear accidents. Please help in pushing this system and my other recommendations. No one else should needlessly suffer the type of tragedy that I and the families of the other victims of Delta Flight 191 are experiencing.

Thank you.

SAFE FLIGHT INSTRUMENT CORP.,
White Plains, NY, October 1, 1985.

Hon. NANCY L. KASSEBAUM,
Chairman, and Members of the Subcommittee on Aviation of the Committee on Commerce, Science and Transportation, U.S. Senate, Washington, DC.

CHAIRMAN KASSEBAUM AND MEMBERS: As president of the Safe Flight Instrument Corporation, which pioneered airborne wind shear warning in the late 1970's, and as the recipient of the Flight Safety Foundation's 1981 Award for Meritorious Service for the development of this technology, I am glad to have this opportunity to make this statement on behalf of the Safe Flight Instrument Corporation and—as I see it—on behalf of the flying public.

The wind shear crash of Delta Airlines Flight 191 at Dallas-Fort Worth in August, which killed 136 people, could have been prevented by existing technology . . . technology that has been delayed because of endless backing and filling by the Federal Aviation Administration.

I cannot repress the horror I feel at the way these lives were tossed away simply because government is content to wait . . . and wait . . . and wait for some sort of "ultimate" technology to guard aircraft from wind shear threats.

Effective anti-wind shear technology exists now—and has existed for the last six years. The Safe Flight Wind Shear Warning/Recovery Guidance System has been FAA certified on over 20 different types of jet aircraft, including the 727, the 747, and the USAF Boeing C-135 used by the Joint Chiefs of Staff.

Analysis of the Delta Airlines flight 191 crash at Dallas-Fort Worth last month proves that existing airborne windshear warning equipment would have prevented the crash and saved 136 lives. The shallow wheel ruts in the open field where Delta 191 first touched lightly down, and its subsequent climb, show that the pilot almost avoided ground contact. Airborne wind shear detection would have alerted him in time to apply power and perform a go-around. With the extra time given by earlier recognition, the crash of delta 191 would never have occurred.

Six IBM executives and their wives were killed in that crash. Ironically, IBM's corporate fleet is equipped with Safe Flight's Wind Shear Warning System, though the Delta aircraft was not.

The success of the Safe Flight technology aboard corporate aircraft has not been lost on the aircraft industry, even if the FAA keeps trying to look the other way. In fact, a whole range of imitators has lately emerged, announcing the airborne wind shear warning they are now planning, and hope to make in the future.

In contrast, the Safe Flight technology is available here and now, and has in fact proved itself in tens of millions of miles flown. The Safe Flight system has been proven, in simulation and in actual flight, to be reliable. It has always given an alert when atmospheric conditions warranted. No 'false alarm' warnings have been reported.

The Safe Flight Instrument Corporation Wind Shear Warning System has been installed on the Boeing 727 simulators of the Federal Aviation Administration, Eastern and United Airlines, and that of the Boeing Aircraft Company itself. The technology was also evaluated on United's 747 simulator, and was most recently installed and on Flight Safety's G-III simulator.

In addition, KLM, Hawaiian, and United Airlines have used the system in passenger service for from six months to a year, to evaluate it for possible fleet retrofit. Moreover, Republic Airlines has indicated its intention to install the Wind Shear Warning System on its new DC-9 simulator.

Corroborating evidence comes from British test pilot Harry Hopkins. Writing in the July issue of Flight International, Hopkins described his recent test of the Safe Flight Instrument Corporation technology in the Eastern Airlines 727 simulator. Hopkins successfully negotiated several extreme shears with the help of the Safe Flight Wind Shear Warning/Recovery Guidance System, but crashed the Simulator twice when the system was turned off.

"The overall outcome was clear," Hopkins said. "Prompt warning of shear, and immediate pitch guidance for recovery, can make all the difference between survival and ground contact during extreme conditions."

Despite the heavy accumulation of evidence attesting to the reliability of the Safe Flight Instrument Corporation's Wind Shear Warning System, FAA is apparently awaiting development of a 'predictive' system. But the ground-based systems—especially Doppler radar for which the agency has requested large developmental grants and subsidies from the Federal Government—may require five, ten or more years before production equipment which satisfies industry needs might be available. If such a system ever does become operational, it will depend on transmitting data to the tower, where it must be interpreted and then relayed to pilots whose aircraft may be threatened. The inherent time lag could be fatal, and we have reason to suppose that it was so in the crash of Delta 191, where the (LLSWAS-generated) warning from the tower came five minutes after the crash.

Doppler radar will have an extremely high cost—$3 to 4 million per airport runway in today's economy—and thus could only be installed at some U.S. airports. What about the other runways? . . . other airports? . . . foreign airports? Moreover, the projected system only takes account of the horizontal component of wind shear. But it is the vertical component—the downburst or microburst—that is the real killer. The vertical component was responsible, for instance, for the tragic accidents at JFK in 1975, at New Orleans in 1982, and at Dallas-Fort Worth only two months ago.

Safe Flight's airborne wind shear warning system was actually developed with the ongoing cooperation of the FAA. In 1982, the FAA issued a Notice of Proposed Rulemaking, stating its intention to require installation of airborne wind shear warning technology by the airlines. In 1984, Advisory Bulletin No. 120-41 was issued, outlining criteria for the manufacture of such technology. Safe Flight's Wind Shear Warning System fully meets these criteria (and indeed, as the only system then in production, was the basis for them). However, since the Advisory, the FAA has taken no further official action with regard to airborne wind shear warning for the airlines.

The Safe Flight Instrument Corporation was founded in 1946 to produce the first stall warning equipment (now standard on aircraft throughout the world). It began its wind shear program in 1975, immediately after the crash of Eastern Flight 66 at JFK. During nearly a decade of concentrated effort to provide wind shear protection, Safe Flight has addressed itself to the aerodynamic solution of the "direct threat" encounter rather than the longer term possibility of advance warning. We have chosen to concentrate our attention on what could be done to provide the earliest possible reduction of vulnerability to the wind shear hazard.

We believe that have accomplished this goal to an extent that justifies the careful consideration of the responsible government agencies, as well as the user community. In the past five years, while safe Flight's proven technology was flying on dozens of corporate jet aircraft, 535 people in the U.S. have died in wind shear-related crashes or major commercial transport. Whether or not Doppler radar or some as yet undreamed of future technology may someday become the "final solution" to wind shear, the American flying public has a present right to the best safety technology available today. We believe the record shows that the Safe Flight Wind Shear Warning System, the only wind shear protection certified by the FAA, is that technology.

We wish to thank the Committee for this opportunity to put our concerns into the record.

Sincerely,

LEONARD M. GREENE, *President.*

[From the September 1985 Airline Executive]

A PROVEN TOOL GOES UNUSED

(By Jerome Greer Chandler)

In the wake of Delta 191, new questions are being asked about the state of the art of wind shear detection. It belabors the point to say that the current Low Level Wind Shear Alert System (LLWSAS) is inadequate. LLWSAS was operating in July 1982 in New Orleans when Pan Am 759 went down. Whether the Clipper's crew fully appreciated the nature of the peril which lay beyond the end of Runway 10 is a matter of debate. LLWSAS is a blunt instrument, one not given to measuring shades of grey.

The System was also working at Dallas/Fort Worth International on the evening of August 2nd when Delta 191 tried to line up with Runway 17 L for final. But because LLWSAS is airport-based, approach paths remain fair game for microbursts—the most insidious form of shear. The DFW system did provided an alert, but only after the point was tragically moot.

Since 1975, there have been two—and depending on the NTSB's finding of probable cause—now perhaps three major fatal accidents attributable to wind shear. The phenomenon is nothing new. Yet, after ten years of official recognition, a credible safeguard system languishes in the bureaucratic labyrinth. Why? Is the technology simply immature, or is it a matter of institutional foot-dragging linked to the ball and chain of a record federal deficit?

To find out some of the answers, Airline Executive talked to Dr. John McCarthy of the National Center for Atmospheric Research in Boulder, CO. In 1982 McCarthy's team conducted the Joint Airport Weather Studies (JAWS) program which confirmed wind shear could be detected by Doppler radar. Some two years later, McCarthy and company followed up with the CLAWS (Classify, Locate and Avoid Wind Shear) project. The first was experimental, the second operational. CLAWS saved at least one airplane.

The technology McCarthy worked with had its beginnings back in 1842 when Christian Johann Doppler discovered that an object's speed and direction can be determined by the wavelengths it emits—be they light waves, sound waves, or radio waves. Applied to radar, the Doppler Principle can determine whether wind-borne moisture is moving in two directions at once—the telltale signature of microburst.

AE—We've known for quite a while that terminal-based Doppler can spot downburst phenomena, can give people adequate warning. Why aren't they in operation right now at major airports across the country?

McCarthy—Well, whereas in 1982 when we did the JAWS project (at Denver Stapleton) we were able to detect microbursts with Doppler, but quite a bit of homework had to be done to affect an operational use of Doppler radar. JAWS was a test program, a research program which was designed to document the existence of these things and get quite a bit of information about them. Doppler was used, incidentally, as a tool to do that—a major tool. It wasn't until 1984, when United just about bought the farm at Denver on the 31st of May due to a microburst, that FAA asked us to come back and use Doppler in a completely operational setting.

AE—Earlier, in 1982, you conducted the $2.2 million JAWS project. How many microbursts did you detect?

McCarthy—All told, it was something like 160 microbursts in 91 days.

AE—That was the experimental phase. FAA asked you to come back after 31 May—the United incident at Stapleton—and put Doppler in an operational mode?

McCarthy—That's right. We did it for 45 days and it was enormously successful. Our Claws project at Stapleton last summer issued 45 microburst advisories with an average of two to four times advance warning to pilots, whereas the LLWSAS was running about one minute late in every case.

Incidentally, we had questionnaires in the cockpits of three carriers. We got about 45 back. One of them stated that an aircraft encountered a plus 25-knot airspeed increase followed by a 30-knot loss, or a 55-knot loss of headwind component. This happened on approach. The pilot reported to us in writing that the advisory, he believes, saved his airplane.

AE—When did he get the advisory?

McCarthy—Several minutes before. He chose, apparently—and I'm speculating exactly what he did because we maintain anonymity—to increase his approach speed and then used his training to continue his approach. Now, one would argue that given definitive microburst advisories the best decision is to avoid. However, given that he did not do that—and there are justifications as to why he would not: a new program, or he wasn't terribly aware of the program—I assume he saved the plane by increasing his approach speed. He flew techniques that maximize your chances of getting through one (a microburst).

AE—You give yourself a pad so that when you have that speed lopped off you're not going to lose lift entirely?

McCarthy—That's right.

AE—So, you're looking at at least one aircraft which has been saved directly as a result of that 45-day operational phase?

McCarthy—Right.

AE—How much money did the FAA give you to operate CLAWS?

McCarthy—$300,000. We proposed to continue that work and they (the FAA) did not continue it. We were expecting to continue it, and then they said they ran out of money. That's one of the several answers to your basic question.

Following JAWS we wrote some papers which stated that one of the serious problems, with Doppler radar in an operational setting is ground clutter. With Doppler radar operating in the terminal environment you have a serious problem with too much ground clutter—too much return from trees, buildings and so forth in the big city environment. This renders detection of microbursts difficult. As a consequence of that, Lincoln Laboratories of MIT was asked to build a test bed radar, the main objective of which was to see if ground clutter could be sufficiently supressed to detect microbursts. That radar was set up to Memphis Airport—actually it's some miles south of Memphis. That radar has been operating all this summer, and most successfully in demonstrating that ground clutter can be adequately suppressed for an operational setting.

AE—So, it's in an operational mode right now?

McCarthy—Well, it's running, but it's providing no ATC or pilot product. It's simply turning and they're collecting data. The decision was made not to provide any real-time service. Again, it was strictly and R&D approach to the problem.

AE—How much would it have cost to provide that information to ATC?

McCarthy—It had some other problems. The radar was designed, the whole plan was designed to test some concepts. The data doesn't come out very nicely in real time. They would have had real difficulty in providing a real-time product. I suppose they could have spent the money to do that, but they chose not to.

AE—So when people today say there is Doppler in Memphis, yes indeed there is Doppler there; but it doesn't have any impact as to whether pilots are going to be apprised of wind shear somewhere out there?

McCarthy—Right. It's providing no real-time product at all.

AE—Is the Doppler equipment at Stapleton still operating?

McCarthy—We operated it all summer for a NOAA (National Oceanic and Atmospheric Administration) program in real-time. But the FAA did not fund us to continue the protection of Stapleton.

AE—It's operating, but it's just not linked to ATC?

McCarthy—That's right.

AE—Isn't this frustrating for you?

McCarthy—(A pause)—Sure it's frustrating. I've been working on this problem, as you know, for some years. I am a goal-oriented person. I want to see this job finished.

We did it last summer in Denver in a human intensive (mode). We had Ph. D. meteorologists out there in the tower providing advisories. All we did was demonstrate that it can be done successfully. That does not mean that you can put it at 20, or 30, or 50 or 100 airports tomorrow and do that.

The Doppler technology works. The sensors work. We can use a Doppler to do this. But we still have to finish the job in making it operationally useful in a routine manner.

AE—You've got the hardware. It's the transfer of that information to the cab and then to the pilot that seems to be the problem?

McCarthy—It's a problem but it's a fully tractable one. It's just a matter of finishing the job, putting the resources there, fast-tracking the work and getting it done.

AE—Reporters are glib with this question, but do you have any ballpark figure as to how much money it would cost to install Doppler at the nation's top ten airports?

McCarthy—$30 million. It's going to come out to be about $3 million a shot.

AE—That includes the hardware and the funding for the people?

McCarthy—Probably, yeah. What we need to do is immediately procure Terminal Doppler radar for whatever number of airports that is. It could be six, it could be thirty or a hundred. The hardware is there. It's the NEXRAD technology, the national Doppler technology.

AE—NEXRAD is a continent-spanning system which looks at weather at all altitudes. This is different from Terminal Doppler which looks at approach and departure within a fairly confined area. Are these two separate projects?

McCarthy—The radar technology is nearly the same. They probably use a different wavelength and the antenna might be different. But the fundamental difference is that we scan this (Terminal Doppler) radar much more frequently over a selected area. NEXRAD refers to 130 national network radars, similar to our current national network. It looks at hurricanes, tornados, fronts, the whole ball of wax. What we need to do is take that same technology and, essentially, focus it on a very tiny area, looking at it with a very high update rate. That's why the two uses are not compatible and we need a terminal derivative from the NEXRAD program. As you know, response time at airports have to be down to one or two minutes minimum in order to maximize a chance of keeping aircraft out of very rapidly changing hazards.

Getting back to your question . . . the technical sensing issues are resolved, in my view. The Memphis work, our work and so on. The fact that we can transfer it (the information) to pilots in a timely manner fundamentally is resolved. Still to be resolved, and fully tractable, is putting the resources into an operational test facility where you attempt to automate this information. We didn't attempt to do that last summer. That is where the ballgame lies.

As with most disasters, there has been political fallout from Delta 191. Congressman Norman Mineta of CA, chairman of the House Aviation Subcommittee, declared shortly after the crash: "This tragedy should put to rest efforts by the White House and OMB to slow funding for implementation of the (Doppler) technology. Hearings on the issue are slated for this fall.

Delta 191 may have been the victim of a classic Texas summer thunderstorm: Vicious, fast-moving and relatively isolated.

Such cells can appear, grow geometrically violent and then disappear in a relatively short period of time. NTSB member G.H. Patrick Bursley said that the storm 191 encountered was isolated, the weather was considered good in other parts of the airport. Dallas-Fort Worth International is the world's second largest airport, roughly the size of Manhattan.

Around 5 pm, weather observers began keeping an eye on a bank of cumulonimbus clouds building to the northeast of DFW. At 5:56, approach control radioed all aircraft: There is a little rain shower just north of the airport and they (other aircraft) are starting to make (instrument) approaches. 191 apparently received the message. As 191 entered the weather, the pilot radioed the local controller: Out here in the rain. Feels good. There was no hint in his voice that there was anything to worry about.

PREPRINT: Second International
Conference on the Aviation
Weather System, June 19-21, 1985,
Montreal, P.Q.

THE CLASSIFY, LOCATE, AND AVOID WIND SHEAR (CLAWS) PROJECT AT DENVER'S STAPLETON INTERNATIONAL AIRPORT: OPERATIONAL TESTING OF TERMINAL WEATHER HAZARD WARNINGS WITH AN EMPHASIS ON MICROBURST WIND SHEAR

John McCarthy
and
James Wilson

National Center for Atmospheric Research*
Boulder, Colorado 80307

1. INTRODUCTION

The National Center for Atmospheric Research (NCAR) conducted an operational test of a microburst forecast, detection, and warning advisory service at Stapleton International Airport, Denver, Colorado, from July 2 to August 15, 1984. The service was based on scientific results from the Joint Airport Weather Studies (JAWS) Project (McCarthy et al., 1982 and McCarthy and Wilson, 1984). The project was called Classify, Locate, and Avoid Wind Shear (CLAWS). Advisories of wind shifts and thunderstorm formation times and locations with respect to the airport were also provided. These advisories gave critical safety information to controllers and pilots, reduced aircraft takeoff, and departure delays, and thus reduced aircraft fuel costs.

In sections to follow, we describe the history of CLAWS, the objectives of the project, the scientific basis for the advisories, the operational procedures, and the results.

2. TECHNICAL AND HISTORICAL BACKGROUND TO CLAWS

Conceived in 1980, the JAWS Project focused on microburst low-altitude wind shear, from both a basic scientific and a research application perspective. Principal findings of the 1982 microburst field experiment at Denver can be summarized as follows:

a. Microbursts are common in Denver. Approximately 160 occurred over the 1600 km^2 research network in 90 days of operation. This averages 1.75 microbursts per day. Furthermore, McCarthy and Wilson (1984) estimated that 20 aircraft are likely to encounter microbursts at Stapleton Airport below 500 ft AGL in a typical summer. Such encounters should be considered serious and life-threatening to the passengers and crew of these aircraft.

b. Microbursts produce intense horizontal diverging outflows at low altitudes, as a result of precipitation induced downflows impinging the surface boundary. The resulting outflows typically produce headwind-to-tailwind speed differences averaging 25 m/s (49 kts), with the maximum documented at 48 m/s (93 kts). Fujita (1983) has documented a microburst which may have had a velocity differential in excess of 77 m/s (150 kts)!

c. At first surface impact, the horizontal extent of the microburst divergence is typically 2 km (6600 ft) in diameter, expanding to 3 km (9800 ft) within the first 5 min after impact.

d. Most microbursts intensify after first impacting the surface. The typical microburst has a 12 m/s velocity differential at impact, doubling to 25 m/s in five minutes. This is important information for a pilot, since a first encounter may not be as severe as a subsequent encounter, indicating that a timely PIREP of this first encounter is critical.

e. Most microbursts last from 5 to 10 min, and are at a peak intensity for 2-4 min. However, some microbursts occur in families, whereby a series of microbursts exist along an apparent line of divergence lasting for up to 30 min.

f. Approximately one-half of the microbursts were associated with relatively weak convection which produced little or no precipitation at the surface. These situations were characterized by high midlevel (500 mb) moisture and near dry adiabatic lapse rates below cloud base. The remainder of the microbursts were associated with thunderstorm convection, characterized by moderate to heavy rain.

Numerous details regarding JAWS results can be found in McCarthy et al. (1982), McCarthy and Wilson (1984), McCarthy and Serafin (1984), Roberts and Wilson (1984), Kessinger (1983), Wilson et al. (1984), Wakimoto (1985), Rodi et al. (1984), and Srivastava (1985).

A near-accident at Stapleton Airport at Denver occurred on May 31, 1984, when United Airlines Flight 663 encountered a significant microburst during its takeoff roll, while still on the runway. All of the classical signs of a microburst were present: blowing dust, virga, a report on the local control fequency of a takeoff wind shear encounter immediately prior to United 663, and a triggering of an alert from the Low Level Wind Shear Alert System (LLWAS).

---

*NCAR is sponsored by the National Science Foundation.

After the aircraft began its takeoff roll, it lost approximately 20 kts of airspeed just as the aircraft was reaching at the critical takeoff speed (V2) of 150 kts. A crash was apparently avoided because the pilot used a new energy trade microburst penetration procedure recently developed by United Airlines and Boeing Commercial Airplane Company, with assistance from JAWS scientists. This technique involves increasing the deck angle to trade airspeed for altitude to minimize altitude loss. After the technique was applied, the aircraft left the runway at ~5 ft off the ground. When it exited the microburst, it rapidly gained altitude, but not before impacting the Instrument Landing System localizer antennas located approximately 1300 ft beyond the departure end of the runway. Several holes in the fuselage created on impact prevented the crew from successfully pressurizing the aircraft on climbout.

NCAR scientists, who were conducting an experiment not associated with wind shear at the time of the accident, confirmed the presence of the microburst after the incident from examination of NCAR Doppler radar and instrumented research aircraft data.

As a result of this incident and its identification as a microburst encounter, the Federal Aviation Administration (FAA) asked the JAWS Project to conduct a microburst real-time forecast and warning service at Stapleton Airport for the remainder of the 1984 microburst season. The CLAWS Project was formed in response to this request, and was planned, funded, and implemented in about 7 days, something of a record for a project of this type!

3. CLAWS OBJECTIVES

The FAA wanted NCAR to provide operational protection for Stapleton Airport in a clearly and recently demonstrated high microburst risk environment. In addition, the objectives of NCAR were to test a number of very short term weather prediction, detection, and warning concepts utilizing results from the JAWS analysis, and to determine whether products developed from these concepts were operationally effective.

A major aim was to obtain a proper mix between scientific and engineering research and the needs of aviation weather product users. We wanted to learn whether a particular set of products, while more than capable of identifying hazards, could provide operationally useful information to air traffic controllers and to the ultimate user, the pilot. The success of the project was based on our ability to modify these products throughout the experiment based on the experience of meteorologists in the tower and feedback from air traffic controllers.

4. OPERATIONAL PROCEDURES

4.1 Experimental Setup of Sensors

Stapleton Airport is the seventh busiest airport in the United States, and is one of the six large airports currently designated by the FAA as a high traffic delay airport. We determined that we could provide protection for Stapleton operations by establishing a disk 5 n mi in radius, centered on the middle of the airport. Located 18 n mi (34 km) northwest of the airport at the NCAR Marshall, Colorado, field site, the NCAR CP-2 10-cm Doppler radar was our principal observational tool.[1] Besides having access to radar information at this site, meteorologists were able to obtain mesonet information from NOAA's Program for Regional Observing and Forecasting Services (PROFS). In addition, the non-recording LLWAS display at Stapleton tower was available. Figure 1 shows the experimental layout.

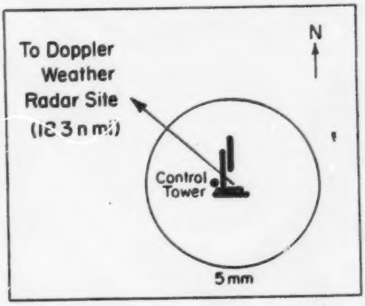


Fig. 1. Experimental layout of CLAWS, showing 5 n mi protection disk, runway configuration, and radar site (off map to northwest).

4.2 Placement of Meteorological Personnel

Two duty stations were maintained from 1100-2000 MDT during CLAWS. The station at the CP-2 Doppler radar at Marshall, Colorado, was manned by two radar meteorologists whose task was to maintain a watch of the Doppler radar data and PROFS mesonet data. Their principal communications task was to transfer timely weather hazard information to two meteorologists at the second station situated in the Air Traffic Control Tower (ATCT) cab at Stapleton. The tower meteorologists interfaced with CP-2 radar meteorologists, provided hazardous weather advisory information to controllers, and maintained visual observations of hazardous weather. To our knowledge, having meteorologists on duty in an FAA ATCT represents a first-of-a-kind situation.

---

[1] The CP-2 site was far from ideal; we could not view the airport at less than 1300 ft AGL, due to elevation differences and beam blockage. Also the viewing angle to Stapleton did not permit measuring wind shear directly along any active runway, an objective of Wilson et al., 1984.

4.3 Types of Weather Products

A number of operational hazardous weather products were developed during CLAWS. They included a daily microburst outlook, present weather status, microburst advisory, wind shift advisory, and thunderstorm initiation advisory. While the principal basis for CLAWS was the microburst advisory, both the wind shift and thunderstorm initiation advisories were added during the project based on the controllers' keen interest.

4.3.1 ATIS Advisory

For each operational day of CLAWS, pilots flying into and out of Stapleton were advised that a special microburst test was in progress by continuous broadcast of the following message on the Airport Terminal Information Service (ATIS):

> "Microburst detection test in progress, advisories will be issued by the tower."

4.3.2 Daily Microburst Probability Forecast

A microburst probability forecast was issued each day at 1100 MDT, providing a probability (%) of microbursts occurring within 25 n mi of Stapleton, for the period 1100-2300 MDT. The concept used depended primarily on atmospheric rawinsonde analysis of the 1200 GMT morning sounding at Denver. Microburst forecasts associated with virga-type convection, partially based on the work of Caracena et al. (1983) and Wakimoto (1985), identified the presence of mid-level moisture near 500 mb, a nearly dry adiabatic lapse rate and very low humidities below cloud base. Forecasts of microbursts occurring in moderate to heavy rain were based on the potential for deep convection in a relatively moist environment. The forecast was posted on the status board, as well as distributed nationally to the aviation system by the Center Weather Service Unit of the National Weather Service at Longmont, Colorado, on the FAA Leased Service A circuit. The intent of the forecast was to alert airline meteorology and dispatch offices and pilots to the likelihood of microbursts at Denver.

4.3.3 Weather Status

In the tower, a routine weather status board was maintained, which identified the level of hazardous threat that was current at any particular time. Six levels of threat were used:

Level 0: No weather echoes near Denver

Level 1: Weather echoes near Denver but not expected to produce wind shear

Level 2: A slight chance for a microburst within the next 15 minutes

Level 3: A chance of a microburst at Stapleton in the next 5-15 minutes

Level 4: A microburst impact at the surface within 5 n mi of Stapleton likely within the next 5 minutes

Level 5: A confirmed microburst at the surface within 5 n mi of Stapleton

The status board was updated by the tower meteorologist whenever an appropriate change occurred, and the board was always available to the ATCT supervisory controller.

4.3.4 Microburst Advisory

Whenever CLAWS personnel confirmed the presence of a microburst within 5 n mi of Stapleton, a microburst advisory was issued to the lead air traffic controller. The advisories were then broadcast to pilots on local control frequencies by the appropriate local traffic controllers. More specifically, advisories were written by the tower meteorologists on a map showing the airport environment, which was then given to controllers. An example advisory reads:

> DATE 7-30-84 TIME 2310 Z: WEATHER RADAR INDICATES A MICROBURST 2 MILES NORTH OF STAPLETON. WIND SHEAR MAY BE 50 KNOTS.

About 80 percent of the microburst advisories were issued on the basis of receipt of guidance from CP-2 radar meteorologists. As expected, because of the less than optimal siting of CP-2, some microburst events were not seen by the radar. To provide a more complete and accurate advisory service, tower meteorologists had to use additional sources of weather information, including the LLWAS display in the tower, visual clues of microbursts on the surface (blowing dust, rings of dust, microburst leading edge dust curls, and virga), and pilot reports of encountered wind shear conditions.

4.3.5 Wind Shift Advisory

We found it quite easy to track thunderstorm, frontal, or other boundary layer wind shift lines with the Doppler radar. When these flows were moving in the direction of Stapleton, a short-term prediction (10-90 min) was made of the expected wind shift. These predictions were informally issued to the lead controller, who began to use the information to change runways in advance of actual wind change. Ordinarily, runways are changed when the actual wind shift passes the field, often causing significant air traffic delays. Our advisories thus provided an substantial improvement in airport efficiency.

4.3.6 Convective Initiation Advisory

Wilson and Carbone (1984) have found, by careful Doppler radar tracking of gust fronts and other boundary layer discontinuities, that thunderstorms frequently form along these boundaries. We observed this process during CLAWS and began to issue informal thunderstorm initiation advisories to the supervisory controller in the ATCT. By advanced forecasts (30-90 min) of thunderstorm time and location with respect to Stapleton, substantially improved air traffic flow efficiency was possible. Because of the informal nature of these advisories, their impact was never formally evaluated, and hence are not discussed in the analysis of results (Sec. 6). Based on discussions at Denver ARTCC, controllers at Stapleton and at the Central Flow Control Facility in Washington said they found the information very useful.

4.4 Example of an Operational Day

July 30, 1984, was an unusually active but not atypical day at Stapleton. The afternoon was characterized by colliding gust fronts directly over the airport, followed by several episodes of microbursts including a line of microbursts (diverging line). Toward the end of the day a hailstorm developed directly over the north end of the airport. Figure 2 shows a 1 hr, 45 min sketch of these weather events (after Stevenson, private communication). Clearly, such a level of activity has quite an aviation system impact!

5. SCIENTIFIC BASIS OF ADVISORIES

5.1 Microbursts

5.1.1 Detection

Wilson et al. (1984) have described the wind structure and characteristics of microbursts in the Denver area. They conclude Doppler radar

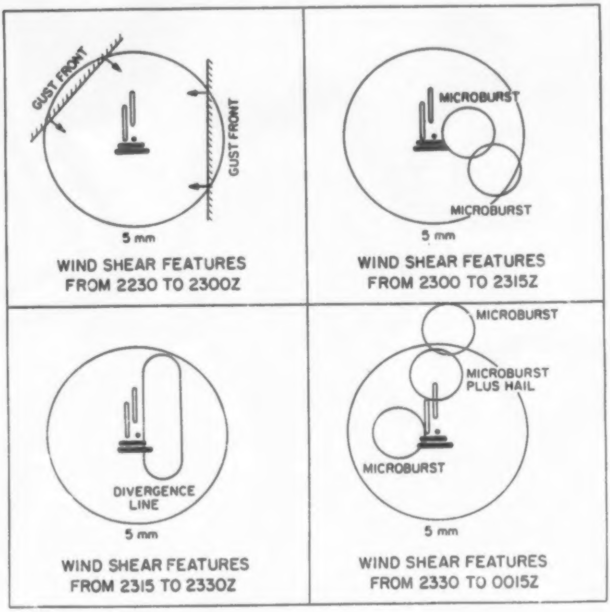

GUST FRONT
GUST FRONT
5 mm
WIND SHEAR FEATURES FROM 2230 TO 2300Z
MICROBURST
MICROBURST
5 mm
WIND SHEAR FEATURES FROM 2300 TO 2315Z
DIVERGENCE LINE
5 mm
WIND SHEAR FEATURES FROM 2315 TO 2330Z
MICROBURST
MICROBURST PLUS HAIL
MICROBURST
5 mm
WIND SHEAR FEATURES FROM 2330 TO 0015Z

Fig. 2. Example of weather hazards at Stapleton during a 1 hr 45 min operational period during CLAWS, on July 30, 1984 (after Stevenson, private communication).

is an effective tool for identifying, locating and monitoring microbursts. However, proper radar placement and scanning strategies are required.

Microbursts are identified on the Doppler velocity display by a distinctive divergent wind signature. Typically, this signature is a couplet of closed velocity contours of opposite sign. The velocity centers are spaced in range 1-4 km apart.

The diverging outflow winds are shallow, with depths between 300 and 1200 m for 90 percent of the 56 JAWS cases studied using Doppler radar. The height of the maximum velocity was ~75 m AGL and decreased slowly above and below this level. As discussed in Section 4.1 the lowest effective height of the CP-2 radar beam over Stapleton during CLAWS was ~450 m (1500 ft). Thus the diverging outflow of most microbursts should still be detected, but as suggested by Fig. 3 in Wilson et al. (1984), the magnitude would be ~75 percent of maximum. The JAWS data analyses also indicated that the horizontal outflow from a microburst was not of equal intensity in all directions. On the average the wind shear along the maximum shear axis was more than twice that along the minimum shear axis. In extreme cases, the differences reached six times stronger. Because of beam height limitations, wind asymmetry, and a radar viewing angle not parallel with the runways, it was not possible to provide quantitative information on the headwind-tailwind differential to be expected. However, because of the need for a quantitative value, a 50 kt wind shear value was given unless the radar observed a stronger value. The 50 kt value was based on the average value observed during JAWS.

5.1.2 Forecasting

Immediately prior to CLAWS, Roberts and Wilson (1984) utilized the JAWS data set to study microburst forcing mechanisms and possible single Doppler forecasting techniques. The radar reflectivity and velocity structure of microburst-producing storms showed great variablitiy without obvious unique features to indicate a microburst was imminent. Divergence was rarely observed aloft prior to microburst impact at the surface and thus was not a useful forecasting tool.

Convergence aloft was a prominent feature in all seven microburst cases studied in detail by Roberts and Wilson (1984). The occurrence of convergence with a descending precipitation shaft is a good indicator of a downdraft. Figure 3 is a time-height cross-section illustrating this phenomena. These features are considered good forecast clues, particularly when coupled with the entrainment of low θ_e air and a dry adiabatic lapse rate below cloud base. Another precursor clue is the actual rotation of the downdraft before the microburst reaches the ground, which is easily detected by Doppler radar. Rotation of the microburst cell was observed in some instances, but not all. Nevertheless, during a field experiment the month prior to CLAWS we were able in real-time to forecast successfully some microbursts by monitoring midlevel convergence and rotation.

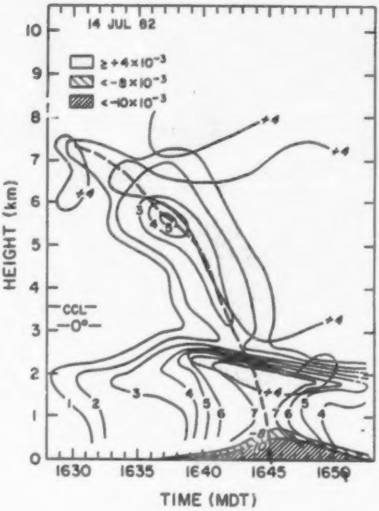


Fig. 3. Time-height display of the reflectivity and estimated divergence for a microburst of 14 July 1982. The solid contours represent the area of the ≥ 45 dBZ$_e$ core in km^2. The divergence is estimated from the radial velocity changes. The dashed line illustrates how the maximum precipitation core descends with time. Note that the maximum near surface divergence (negative values cross hatched) occurs immediately following the precipitation core reaching the ground. Convergence at midlevels and again just below the freezing level is indicated by the light shading (positive values).

During CLAWS the CP-2 meteorologists monitored the descent of refectivity cores, midlevel convergence, and midlevel rotation, but without computer assistance were unable to provide quantititive evaluation. Instead, these features were subjectively monitored. The typical microburst forecasting scenario involved the examination of the velocity and reflectivity display at high magnification for midlevel convergence and rotation of cells over Stapleton. When these features were present, a microburst advisory was issued at the first signs of surface divergence. Without these midlevel signs an advisory was not issued until the observed velocity differential reached 10 m/s on the lowest scan. Because microbursts tend to increase in intensity for the first 5 min following surface impact of the downdraft, these techniques usually ensured that advisories were issued before the maximum wind shears occurred.

5.2 Wind Shifts

Wind shift lines occurring near the ground can be easily identified and tracked by Doppler radar (Wilson and Wilk, 1982). In optically clear air the wind shift boundary shows on the reflectivity display as a thin line, 1-2 km wide, of enhanced reflectivity, and on the velocity display as a line of confluent flow. In precipitation regions the wind shift line can be observed only on the velocity display. Typically, the boundaries move at a constant speed and can be accurately extrapolated for at least one hour. These wind shift lines commonly result from gust fronts (cold outflows from convective storms) or are induced by the terrain. Others may be of synoptic scale origin (e.g., a cold front) or of very local origin such as differential heating resulting from spatial variations in cloud cover or soil and vegetation variations. Wind direction can be closely approximated by a line normal to the orientation of the boundary. Surface wind speed is approximated by two methods. The first method assumes the wind speed is slightly larger than the propagation speed of the boundary. In the second method, if the boundary is propagating toward or away from the radar, the Doppler velocity can be used as an estimate of wind speed. During CLAWS the CP-2 meteorologist used these techniques plus close monitoring of the PROFS mesonet stations to provide approximately 30 min forecasts of wind shifts at center field.

5.3 Thunderstorms

Preliminary studies with Doppler radar show that $\sim$50 percent of the storms affecting the Denver area initiate over mountains and elevated terrain to the west and south. Thus storms can be tracked and forecasts provided based on extrapolation techniques. The other 50 percent initiate along convergent wind lines over the plains so close to Stapleton that extrapolation forecasts would provide little warning.

We found that 63 percent of the convergent wind line boundaries initiated storms. The meteorologist can be quite certain storms will form only along these boundaries, so he can focus his forecasts on when and where they will occur on the the boundary. Visual observations of cloud development along the lines and surface observations of temperature and moisture from the PROFS mesonet stations were used to anticipate the initiation of deep convection on these boundaries.

The collision or intersection of two boundaries nearly always produced thunderstorms during the afternoon or evening when surface temperature and moisture conditions indicated that deep convection was possible with a slight trigger. The presence of nearby thunderstorms was confirmation that conditions were suitable for thunderstorm development.

When two boundaries were extrapolated to collide near the airport and the meteorologist believed conditions were suitable for free convection, an informal thunderstorm advisory for location and time was issued. The time of the thunderstorm was predicted to occur 20-30 minutes following boundary collision.

6. ANALYSIS OF RESULTS

Although CLAWS was planned and implemented in a very rapid manner, a substantial effort was undertaken to assess the effectiveness of the project. The primary evaluation effort, directed toward an independent assessment of air traffic and pilot impact of CLAWS advisories, was conducted by Mr. Lloyd Stevenson, Transportation Systems Center, U.S. Department of Transportation, Cambridge, Mass.[1] The following steps were involved with the evaluation:

- NCAR meteorologists both at the radar and at the tower maintained a detailed daily log regarding all activities, including the issuance of advisories.
- Special forms for microburst and wind shift advisories were maintained by the tower meteorologists.
- After each advisory period was completed, a special evaluation form designed by Stevenson was used to develop a preliminary assessment of impact of the advisory on ATC.
- Pilot questionnaires, placed in the cockpit of the three major air carriers which operate into Stapleton, were designed to assess the quality and usefulness of our microburst advisories. These questionnaires were anonymous, and $\sim$40 were returned to NCAR and used in the ATC and pilot impact analysis.
- Audio tapes of each microburst and wind shift advisory period, taken from the ATCT local controller frequencies, were cataloged and later evaluated by Stevenson.

Each microburst and wind shift advisory was documented as to location and time, pertinent meteorological parameters (i.e., intensity, direction of movement, longevity, etc.), and a variety of ATC and pilot impacts. All wind shear and turbulence pilot reports recorded on the local controller frequencies were catalogued as a means of verifying the accuracy and timeliness of advisories. The collection of all of the various meteorological logs, forms, tower tapes, and debriefings of controllers allowed Stevenson to determine a number of important statistics.

6.1 Summary of Advisories Issued

The following summarizes the number and types of advisories issued between July 2 and August 15, 1984, between the operational hours of 1100 and 2000 MDT as determined from an examination of daily logs prepared at both the CP-2 radar and the tower:

MICROBURST ADVISORIES ISSUED	30
LINE OF MICROBURSTS, (OR DIVERGING LINE) ADVISORIES ISSUED	5

---

[1] A report by Mr. Stevenson is expected to be published by FAA in the spring of 1985, entitled "The Stapleton Microburst Advisory Service Experiment: An Operational Viewpoint."

WIND SHIFT (OR GUST FRONT) ADVISORIES ISSUED	32
TORNADO (GUSTNADO) ADVISORY ISSUED	1

6.2 Advisory Analysis

The intensification of microbursts after first impact with the earth's surface, documented in JAWS, was confirmed in CLAWS by Stevenson's analysis. His principal method of verifying the impact of microburst advisories was to document the time sequence of aircraft encounter, as reported through the local controller, and hence recorded for analysis on audio tape. Because the protection area was 5 n mi in radius, much of which was outside of any low altitude aircraft operations, Stevenson was able to verify only 10 microburst advisories by PIREP. In those verified advisories, reported wind shear intensity on first encounter increased in later encounters, and then was followed by decreasing intensity. Typically, the increasing intensity portion lasted 2 to 3 min, supporting the previous Doppler radar statistic. Of the 30 microburst advisories and 5 diverging line (microburst) advisories issued (a total of 35 events), only 10 affected operations as documented on audio tape via PIREPs to controllers. For each of the 35 events, the tower meteorologist indicated on the advisory form which of three ways was used to issue advisories: CP-2 radar, tower visual sighting or LLWAS. Of the 10 verified by Stevenson, 5 were initiated by radar, 3 by visual sighting, and 2 by LLWAS. This does not mean that other sensors did not detect the event after the initial advisory was issued. The following chart indicates the advanced (or reactive) nature of the microburst advisories:

SENSOR TYPE	NUMBER OF EVENTS	FIRST ENCOUNTER PIREP	MAXIMUM SHEAR PIREP
CP-2 RADAR	5	2 MIN EARLY	4 MIN EARLY
TOWER VISUAL SIGHTING	3	3 MIN LATE	2 MIN EARLY
LLWAS	2	2 MIN LATE	<1 MIN LATE

These important statistics, while having a small sample size, indicate that Doppler radar provided a quantum improvement in microburst detection and warning capability during CLAWS, giving a 4 min advanced warning to pilots prior to a maximum shear encounter. Importantly, visual sightings of microbursts by trained meteorologists from the tower provided a reasonable advanced warning capability for maximum shear encounters. Of course, there was a lag for first encounters. Unfortunately, the LLWAS as configured at Stapleton in 1984 failed to provide advanced warning, even for the maximum shear encounter, at least for the 2 cases verified by PIREPs. An improved LLWAS array has since been installed at Stapleton.

The Stevenson analysis provided additional insight into the microburst advisories. Each advisory was assigned a centerpoint in space, inside the 5 n mi disk. This location was then normalized with respect to both the active approach-to-landing runway(s), and to the departure runway(s). Figure 4 shows the total number of microburst advisories plotted in this framework for approach-to-landing cases. For this case, the diverging line microbursts were combined with the singular microbursts, so the total number of events is 35, where the center point of these lines represents the principal microburst center. The numbering in Fig. 4 represents the chronological event number. For example, event 10 represents a microburst that occurred 3.7 n mi from the active runway, almost directly across from the touchdown point (note that any indication of right or left of centerline is folded into a single axis). However, event 11 is located directly on the runway centerline, and 0.75 n mi short of the runway touchdown point. Consequently, we would expect that event 10 should have little or no impact on aircraft, while event 11 should have a significant impact.

The documented PIREP is indicated for each advisory event, by the presence or absence of a black edge to the advisory oval. If one or more aircraft reported wind shear, but took no evasive action, the left side of the oval is darkened. If one or more aircraft executed a missed approach, both sides of the oval are darkened. Thus, event 10 was not encountered, as we would expect, while event 11 stimulated at least one missed approach. Clearly, events outside of the largest dotted box had no documented effect on aircraft trying to land at Stapleton, while aircraft inside both dotted boxes were affected. Those aircraft inside the smaller box encountered more serious shear, resulting in missed approaches.

Figure 5 gives a similar presentation, but with respect to the normalized departure runway(s). In this case a double darkened oval represents one or more aircraft that delayed their departure. While boxes have not been placed as in the previous figure, the same conclusion is seen. In any future advisory service, it will is critical for microburst advisories to be issued for zones close to the active approach or departure runway, and to disregard microbursts further removed from the action. However, we believe the quantitative presence of microbursts in the periphery zone probably would be useful information for controllers and pilots.

6.3 The Pilot Questionnaire - A Surprise

As mentioned earlier, about 40 pilot questionnaires were returned to NCAR for subsequent analysis, to help verify and supplement comments which appeared on tower tape. Because of the pilot questionnaires, we were able to obtain substantial additional feedback that enabled us to refine the operational products of CLAWS.

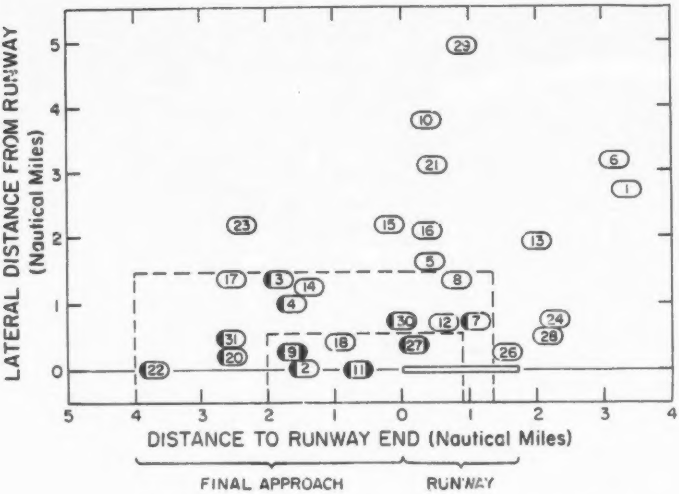


Fig. 4. Location of microburst advisory center points, normalized with respect to active approach-to-landing runway (distance right or left is combined onto one axis). For ovals not filled in, no PIREP win shear encounter was reported. If the left side of oval is darkened, one or more aircraft reported shear during this advisory. If both sides are darkened, one or more aircraft executed a missed approach. Dashed boxes reflect varying degrees of risk areas.

The most typical comment came from pilots who wanted microburst advisories to be more quantitative so that actual headwind/tailwind losses can be made known to them. For example, with the offset siting of our Doppler radar, we were unable to examine runway component wind shear. That is, we never had a radar looking precisely along a runway (see Fig. 1).

Pilots also noted that some advisories were "out in left field," in that those particular microbursts would probably not be encountered during their flight. This reality is clearly seen in Figs. 4 and 5.

Finally, we were gratified to receive one questionnaire from a pilot who stated that the microburst advisory he received was accurate and timely, and went on to say: "By just having this available--note we were a heavily loaded 737 in the critical approach phase--this warning in advance may have just saved an aircraft from being forced into the ground short of the runway." This encounter is identified as microburst event #31 in Fig. 4.

6.4 ATC Impact of Wind Shift Advisories

Informal feedback from controllers suggested that wind shift advisories apparently affect the aviation safety issue to a lesser extent than the airport efficiency issue. Advanced warnings averaging 22 min allowed ATC to plan runway changes in a considerably more orderly way. For example, controllers would have departing aircraft lined up on the appropriate runway prior to the gust front passage, while approaching aircraft were adjusted to new runways in advance. Without an advisory service, these changes are made as the wind shifts actually hit the runways, often resulting in missed approaches and delayed departures, while controllers adjust the airport runway configurations in arrears.

We have not yet performed a detailed cost/benefit analysis of the economic effects of wind shift advisories; Stevenson's analysis will address this in some detail. However, flight operations and air traffic specialists have indicated that the fuel savings alone at Stapleton during these CLAWS wind shift episodes resulted in several hundreds of thousands of dollars in savings for the airlines during the project. Recently, Stevenson has estimated that an advisory service similar to CLAWS would provide no less than $850,000 in annual fuel savings at Denver.

7. CONCLUSIONS

The CLAWS Project was unique in aviation research and development efforts, because it

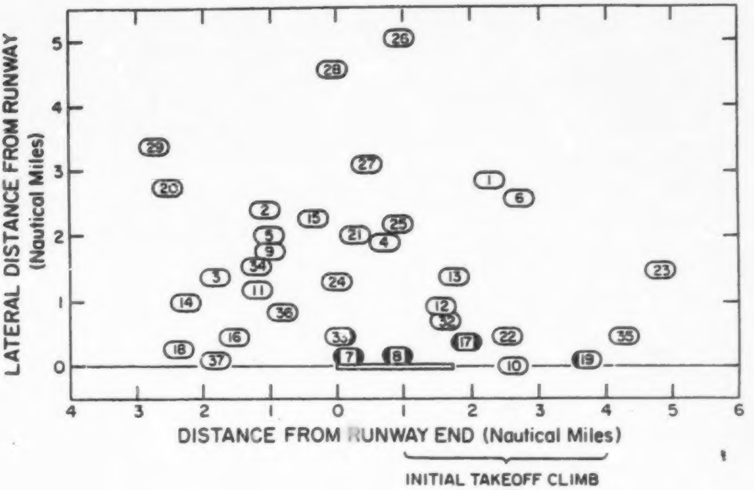


Fig. 5. Same as Fig. 4, except normalized to departure runway. Double darkened advisory oval refers to disrupted departure (i.e., a delay of takeoff roll).

quickly implemented R&D efforts into operations. CLAWS provided ATC and pilots with critical advanced microburst forecasts, real-time warnings, timely wind shift forecasts, and to some extent, thunderstorm time and location forecasts, and simultaneously helped NCAR/JAWS to apply and substantially improve JAWS-based forecasting and warning techniques.

CLAWS is sharply contrasted to typical R&D efforts that are hardware limited rather than operationally product-driven. We developed quantitative and usable products identified by on-line operational testing, continued scientific and technical refinement of products usable in a national system.

An important but unanticipated value of CLAWS was the decrease in air traffic delays caused by severe weather. The CLAWS program not only produced effective microburst advisories that improved aviation safety but also addressed the ATC capacity issue facing major airports such as Denver.

Finally, critical findings from CLAWS can be summarized as follows:

- The advance warning capability of Doppler radar to provide microburst and wind shift warnings was clearly demonstrated.
- Pilots clearly stated their need for accurate quantitative estimates of actual wind shear along the approach/departure runways, rather than a semi-qualitative indication of microburst location.
- The area of aviation microburst warnings could be greatly reduced to the immediate region of aircraft approach/departure operations.

8. ACKNOWLEDGMENTS

Many persons were involved during the successful conduct of CLAWS. At the FAA headquarters in Washington, James Dziuk, Donald Turnbull, and Lou Cusimano were vital to initiating CLAWS; FAA/Denver personnel included Frank Johns, Dave Laschinger, and Walter Flood. From the NWS, Brian Heckman and Fred Foss contributed in the early stages.

All of the JAWS staff made major contributions; particularly Mark Hjelmfelt, Wendy Schreiber Cathy Kessinger, Kim Elmore, and Phyllis O'Rourke, with many extra hours spent on the line. However, several others within the Atmospheric Technology Division of NCAR made major contributions, including Cindy Mueller, Brian Lewis, Bob Baron, Jim Moore, Jon Lutz, Rit Carbone, Peter Hildebrand, and Robert Serafin.

NCAR assistance from outside ATD by Cleon Biter, Ron Rinehart, and Jack Hinkelman was deeply appreciated.

A small part of the operational analysis work of Lloyd Stevenson, DOT Tranporation System Center, Cambridge, Mass., has been included in this paper. We consider his efforts to have been a outstanding contribution to CLAWS, which we deeply appreciate. The vital assistance of the NOAA/ERL PROFS program is acknowledged. CLAWS was funded under Interagency Agreement DTFA01-82-Y-10513 between the FAA and the National Science Foundation, which sponsors NCAR.

REFERENCES

Caracena, F., J. McCarthy, and J.A. Flueck, 1983: Forecasting the Likelihood of Microbursts along the Front Range of Colorado. Preprint Vol. 13th Conf. on Severe Local Storms, Oct. 17-20, Tulsa, Okla. Published by the Amer. Meteor. Soc., Boston, Mass., 261-264.

Fujita, T.T., 1983: Andrews AFB Microburst. SMRP Research Paper 205. Dept. of Geophysical Sciences, Univ. of Chicago, 38 pp.

Kessinger, C., M. Hjelmfelt, and J. Wilson, 1983: Low-Level Microburst Wind Structure Using Doppler Radar and PAM Data. Preprint Vol. 21st Conf. on Radar Meteorology, Edmonton, Alta., Sept. 19-23. Published by the Amer. Meteor. Soc., Boston, Mass., 609-615.

McCarthy, J., and R. Serafin, 1984: The Microburst Hazard to Aircraft. Weatherwise, Vol. 37, No. 3, 120-127.

McCarthy, J., and J.W. Wilson, 1984: The Microburst as a Hazard to Aviation: Structure, Mechanisms, Climatology, and Nowcasting. Proc. Nowcasting-II Symposium, Norrkoping, Sweden, Sept. 3-7, 21-30.

McCarthy, J., J.W. Wilson, T.T. Fujita, 1982: The Joint Airport Weather Studies Project. Bull. Amer. Met. Soc., Vol. 63, No. 1, 15-22.

Roberts, R., and J. Wilson, 1984: Precipitation and Kinematic Structure of Microburst Producing Storms. Conf. Vol. 22nd Conf. on Radar Meteorology, Sept. 12-13, Zurich, Switzerland. Published by the Amer. Meteor. Soc., Boston, Mass., 71-76.

Rodi, A.R., K.L. Elmore, and W.P. Mahoney, 1983: Aircraft and Doppler Air Motion Comparisons in a JAWS Microburst. Preprint Vol. 21st Conf. on Radar Meteorology, Edmonton, Alta., Sept. 19-23. Published by the Amer. Meteor. Soc., Boston, Mass. 624-629.

Srivastava, R.C., 1985 (in press): A Simple Model of Evaporatively Driven Downdraft: Application to Microburst Downdraft. J. of Atmos. Sciences.

Wakimoto, R., 1985 (in press): Forecasting Dry Microburst Activity over the High Plains. To be published in Mon. Wea. Review.

Wilson, J., and R. Carbone, 1984: Nowcasting with Doppler Radar: The Forecaster Computer Relationship. Proc. Nowcasting-II Symposium, Norrkoping, Sweden, Sept. 3-7, 177-18[illegible].

Wilson, J.W., C. Kessinger, R.D. Roberts, and J. McCarthy, 1984: Microburst Wind Structure and Evaluation of Doppler Radar for Wind Shear Detection. J. of Climate and Applied Meteorology, Vol. 23, 898-915.

Wilson, J.W., and K. Wilk, 1982: Nowcasting Applications of Doppler Radar. In Nowcasting (K.A. Browing, Ed.), Academic Press, London and New York, 87-105.